CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

REGIONAL WATER QUALITY CONTROL BOARD

CENTRAL VALLEY REGION

AMENDMENTS

TO

THE WATER QUALITY CONTROL PLAN FOR THE SACRAMENTO RIVER AND SAN JOAQUIN RIVER BASINS

FOR

PH AND TURBIDITY

AT

DEER CREEK EL DORADO & SACRAMENTO COUNTIES

STAFF REPORT

AND

FUNCTIONAL EQUIVALENT DOCUMENT

Draft Report

February 2002

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LIST OF ACRONYMS

CCR .... California Code of Regulations
CDFG .... California Department of Fish and Game
CEQA .... California Environmental Quality Act
CFR .... Code of Federal Regulations
cfs .... cubic feet per second
CWA .... Clean Water Act (Federal Water Pollution Control Act)
DCWWTP .... Deer Creek Waste Water Treatment Plant
DHS .... California Department of Health Services
EID .... El Dorado Irrigation District
EPA .... Environmental Protection Agency
ESA .... Federal Endangered Species Act
F .... Fahrenheit
FR .... Federal Register
JSA .... Jones and Stokes Associates
mgd .... million gallons per day
NMFS .... National Marine Fisheries Service
NPDES .... National Pollutant Discharge Elimination System
NTUs .... Nephelometric Turbidity Units
OAL .... Office of Administrative Law
RWQCB .... Regional Water Quality Control Board
SRCSD .... Sacramento County Regional Sanitation District
SRWTP .... Sacramento Regional Wastewater Treatment Plant
SSBPA .... Site-Specific Basin Plan Amendment
SWRCB .... State Water Resources Control Board
SWRI .... Surface Water Resources, Inc.
TSS .... total suspended solids
U.S. EPA .... United States Environmental Protection Agency
USFWS .... United States Fish and Wildlife Service
WWTP .... wastewater treatment plant

1 INTRODUCTION

This Staff Report is the central planning documentation required by the California Water Code for adoption of Regional Water Quality Control Board, Central Valley Region (Regional Board) proposals for Basin Plan amendments. The report also serves as the California Environmental Quality Act (CEQA) environmental impact assessment document (Functional Equivalent Document) required for Basin Plan amendments.

The remainder of this section provides regulatory context for Basin Planning, defines the purpose and need for revisions to the Basin Plan proposed in this Staff Report, the scope of proposed revisions, and defines the purpose and intended use of this Staff Report in the overall Basin Plan amendment process.

1.1 BACKGROUND

1.1.1 Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins

A Water Quality Control Plan, or Basin Plan, is the basis for regulatory actions by Regional Boards that are to be taken for water quality control. Each of the nine Regional Boards in California has adopted a Basin Plan for its geographic region.

The preparation and adoption of a Basin Plan is required by California Water Code Section 13240 and supported by the federal Clean Water Act (CWA or Act). Section 303 of the CWA requires states to adopt water quality standards which consist of the designated uses of the navigable waters involved and the water quality criteria (referred to as "objectives" in California) for such waters based upon designated uses. A Basin Plan must consist of all of the following (Water Code Section 13240-13244):

a) beneficial uses to be protected;
b) water quality objectives;
c) a program of implementation needed for achieving water quality objectives; and
d) surveillance and monitoring to evaluate the effectiveness of the program.

Basin Plans are adopted and amended by the Regional Board using a structured process involving peer review, full public participation, state environmental review, and state and federal agency review and approval.

It is the intent of the State Water Resources Control Board (State Board) and Regional Boards to maintain the Basin Plans in an updated and readily available edition that reflects the current water quality control program. The Water Quality Control Plan (Basin Plan) for the Sacramento and San Joaquin River Basins was first adopted in 1975. In 1989, a second edition was published. The second edition incorporated all the amendments which had been adopted and approved since 1975, updated the Basin Plan to include new state policies and programs, restructured and edited the Basin Plan for clarity, and incorporated the results of triennial reviews conducted in 1984 and 1987. In 1994 a third edition was published incorporating all amendments adopted since 1989, including new state policies and programs, restructuring and editing the Basin Plan to make it consistent with other regional and state plans, and substantively amending the sections dealing with beneficial uses, objectives, and implementation programs. The current edition (Fourth Edition 1998) incorporates two new amendments adopted since 1994. One amendment deals with compliance schedules in permits and the other addresses agricultural surface drainage discharges.

Since publication of the Fourth Edition, the federal rules regarding U.S. EPA approval of water quality standards have changed. When a state adopts a water quality standard that goes into effect under state law on or after May 30, 2000, it becomes the applicable water quality standard only after U.S. EPA approval, unless the U.S. EPA promulgates a more stringent water quality standard for that state, in which case the U.S. EPA promulgated water quality standard is the applicable water quality standard for purposes of the CWA (65 FR 36046 codified at 40 CFR 131.21). This new regulation applies to all surface waters of the state.

1.1.2 Regulatory Authority and Mandates for Basin Plan Amendments

The State Board and the nine Regional Boards are the principal state agencies with regulatory responsibility for coordination and control of water quality. The Porter-Cologne Water Quality Control Act (California Water Code Section 13000 et seq.) establishes the requirement to adopt and revise state policy for water quality control. Basin Plans adopted by the Regional Boards must conform to these policies.

Authority for each Regional Board to formulate and adopt Basin Plans and periodically review the plans is provided in Section 13240 of the Water Code. However, a Basin Plan does not become effective until approved by the State Board (Water Code Section 13245), and the Office of Administrative Law (OAL). If the amendment involves adopting or revising a standard which relates to surface water, it must also be approved by the U.S. EPA [40 CFR 131.21] before it goes into effect.

Section 303 of the CWA requires states to adopt water quality standards for surface waters "…*from time to time*…" and "…*as appropriate*…." Standards consist of designated uses and criteria (referred to as "objectives" in California) to protect those uses. These requirements also are found in the Code of Federal Regulations (CFR), primarily 40 CFR 130 (which covers water quality planning and management) and 40 CFR 131 (which covers water quality standards).

The Regional Board also must comply with the requirements of the California Environmental Quality Act (CEQA) (Public Resources Code Section 21000 et seq.) when amending the Basin Plan. The planning process for Basin Plans has been certified by the Secretary of Resources as a regulatory program pursuant to Public Resources Code Section 21080.5. CEQA Guidelines § 15251(g). Pursuant to Public Resources Code section 21080.5(c), the Basin Plan planning process is exempt from the provisions of the CEQA that relate to preparation of Environmental Impact Reports and Negative Declarations. In lieu of compliance with those provisions of CEQA, Section **9** (CEQA Review) of this Staff Report satisfies the requirements of State Board Regulations for Implementation of CEQA, Exempt Regulatory Programs, which are found in the California Code of Regulations, Title 23, Division 3, Chapter 27, Article 6, beginning at Section 3775.

1.1.3 Purpose and Need for the Proposed Revisions To The Basin Plan

In its most recent (1999) triennial review of the Basin Plan, as required by the CWA, the Regional Board identified as a top priority the need to further develop solutions to water quality regulation problems common to effluent-dominated water bodies, like Deer Creek. Among the most notable and widespread water quality regulation problems for effluent-dominated water bodies are the inability of tertiary municipal wastewater treatment plants to consistently comply with NPDES permit receiving water limitations derived directly from the Basin Plan's current pH and turbidity objectives. Moreover, the current pH and turbidity objectives are not strongly supported by the current science regarding effects of these parameters on aquatic life (**Appendix C**), nor are they consistent with current U.S. EPA guidance for regulating pH and turbidity in ambient waters (see Sections 4.1.2.2 and 4.2.2.2, respectively). Consequently, Regional Board staff have identified modification of current Basin Plan pH and turbidity objectives for effluent-dominated water bodies as a high basin planning priority.

The focus of this Staff Report is to evaluate the existing water quality objectives for pH and turbidity in Deer Creek, determine if changes to the currently applicable objectives for these parameters are appropriate, and, if so, propose and technically support such changes. This is consistent with the Regional Board's basin planning priority to address regulatory issues associated with effluent-dominated water bodies. The need for modifying the current Basin Plan pH and turbidity objectives was, in part, brought to Regional Board staff's attention through renewal of the Deer Creek Wastewater Treatment Plant's (DCWWTP) NPDES permit in 1997. The DCWWTP is owned and operated by the El Dorado Irrigation District (District).

Extensive discussions between Regional Board and District staff revealed that pursuing Site-Specific Basin Plan Amendments (SSBPA) for Deer Creek offered an appropriate and reasonable means of: 1) updating the scientific basis for pH and turbidity objectives applicable to this water body; 2) solving the current NPDES compliance problems associated with receiving water pH and turbidity in this seasonally effluent-dominated water body in a manner that protects and maintains beneficial uses; and 3) solving these regulatory issues in the most cost-effective and environmentally sound manner. Potential alternative means to resolving these water quality regulatory issues at Deer Creek (e.g., Option 1 – Additional Treatment Facilities; Option 2 – Effluent Reuse; and Option 3 – Connection to Sacramento Regional Wastewater Treatment Plant) are discussed in detail in Section 9 (CEQA Review) of this Staff Report.

1.1.4 Background on Deer Creek

Deer Creek is a small creek draining the lower woodlands of the western Sierra Nevada foothills, in El Dorado and Sacramento counties. Deer Creek is the principal watercourse of its watershed, which covers approximately 17 square miles in the vicinity of Cameron Park. Its headwaters originate just north of Cameron Park Lake.

Precipitation and runoff sustain flows in Deer Creek during wet weather. Natural flow into Cameron Park Lake generally stops between May 15 and June 1 (SWRCB 1995). Leakage from the dam at Cameron Park Lake, springs, and urban runoff supply the creek's water downstream of the dam during the non-precipitation period of the year (SWRCB 1995). Summer base flows, upstream of the DCWWTP, have been documented in the range of 0.16-0.28 mgd (0.25-0.43 cfs) (SWRCB 1995). Unlike higher elevation creeks that receive perennial water supplies from snowpack, Deer Creek's small, low-elevation watershed does not hold snowpack (Beak 1990).

Deer Creek's terminal drainage is the North Fork of the Cosumnes River (**Figure 1**). Regional Board staff observations during 1999 indicate that hydraulic continuity between Deer Creek and the Cosumnes River may exist year-round. Flows in this creek go subterranean in various locations (e.g., near Scott Road), but are still believed to be hydraulically connected to the Cosumnes River.

In 1974, the District began operating the DCWWTP, which is located on Deer Creek approximately 2.2 miles south of Highway 50. Currently, discharge of tertiary-treated effluent from the DCWWTP constitutes the majority of Deer Creek's flow below the point of discharge during the low-flow summer/fall period of the year. Consequently, Deer Creek is an effluent-dominated water body below the DCWWTP's point of discharge during much of the year, particularly the June through October period, with reaches downstream of the Latrobe Road Bridge being effluent dependent during the summer and fall months.

The minimal dilution offered by the receiving water during the late spring, summer, and fall periods of the year (and even other periods during drier conditions) coupled with Deer Creek's inherent pH and turbidity conditions results in a situation where the receiving water objectives for pH and turbidity stated in the Basin Plan cannot be consistently achieved downstream of the point of effluent discharge. This is true despite the high-quality effluent being discharged to the creek, as documented by post-upgrade discharge monitoring reports, bioassay results, and results of fish and benthic macroinvertebrate surveys conducted above and below the DCWWTP (See Section 3.2.1).

1.1.5 Scope of Revisions to the Basin Plan

The amendments to the Basin Plan proposed in this Staff Report are for Deer Creek only. Although the proposed revisions to the pH and turbidity objectives may have basin-wide applicability, particularly for effluent-dominated water bodies, this broader application is not being addressed by this Staff Report at this time.

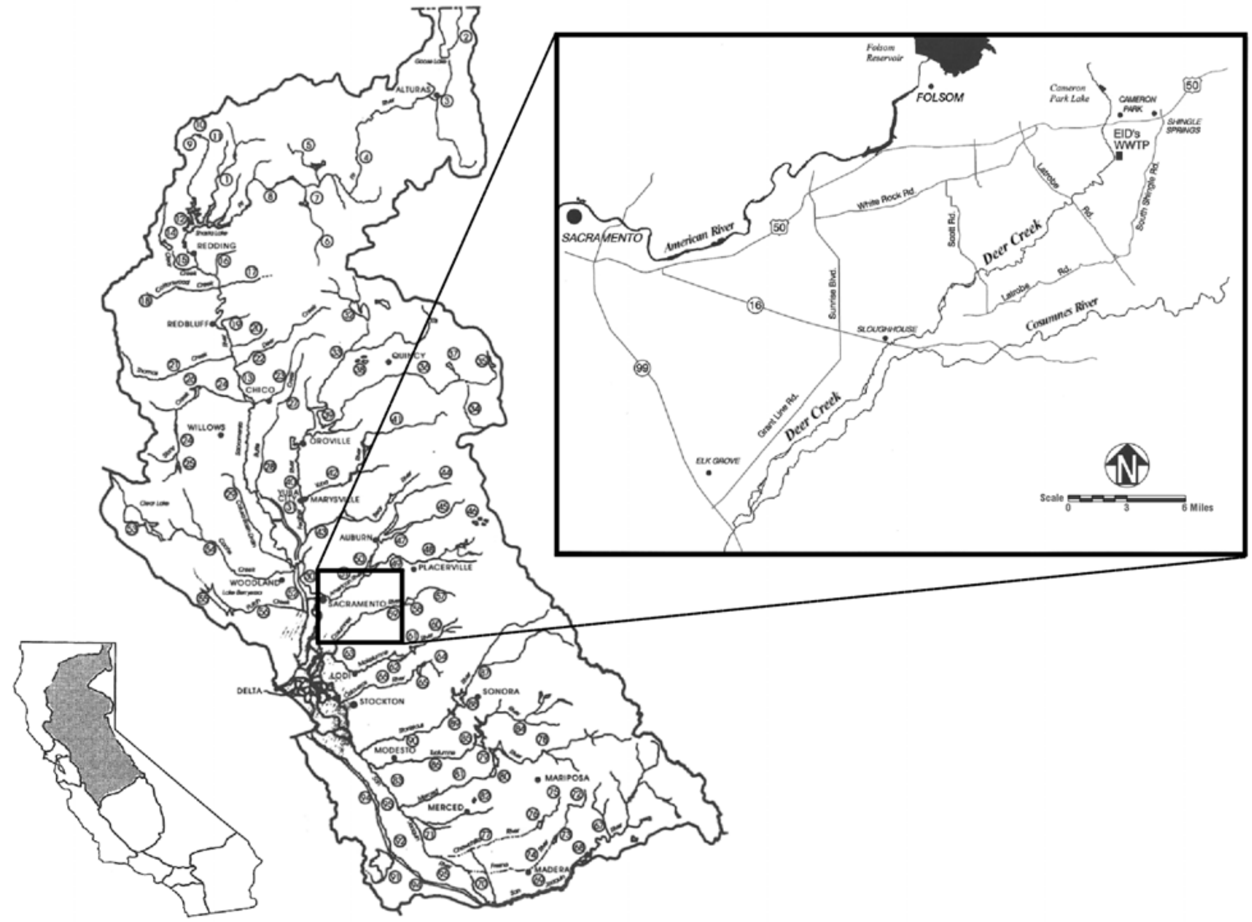


Figure 1. Location of Deer Creek within the San Joaquin River Basin of the Central Valley Region, California

If adopted, the proposed Basin Plan amendments would result in:

1) modification to the current pH and turbidity objectives for Deer Creek;
2) establishment of a surveillance and monitoring program, which makes maximal use of existing programs, to evaluate compliance with the revised objectives and their protection of beneficial uses.

As part of the SSBPA process, site-specific technical information has been compiled for Deer Creek pH and turbidity, both above and below the DCWWTP, which characterizes existing conditions. In addition, a compilation of the pH and turbidity requirements of freshwater aquatic life is provided. This information is presented in the appendices of this Staff Report.

1.2 PURPOSE AND INTENDED USE OF THIS STAFF REPORT

The purpose of this Staff Report is to define and provide support for the proposed Basin Plan amendments, presented herein, and to provide the rationale behind each part of each amendment. **Section 1** (Introduction) provides historical and regulatory background for the Basin Plan amendment process, defines the purpose and need for the proposed site-specific amendments, and provides a brief background on Deer Creek. **Section 2** (Summary of Proposed Amendments to the Basin Plan) presents the modifications to current pH and turbidity objectives that constitute the proposed amendments, and a brief discussion on the intent of each amendment. **Section 3** (Beneficial Uses) discusses Deer Creek's beneficial uses. **Section 4** (Water Quality Objectives) discusses the rationale for the proposed amendments. **Section 5** (Antidegradation Analysis) evaluates the proposed amendments with respect to the federal and state antidegradation policies. **Section 6** (Programs for Implementation of Site-Specific Objectives) discusses the need for and rationale behind the program for implementation of site-specific objectives and the time schedule for compliance. **Section 7** (Surveillance and Monitoring) describes water quality and biological monitoring that will occur, should the proposed amendment be adopted, to assess both compliance and effects on beneficial uses. **Section 8** (Endangered Species Act Considerations) summarizes the results from technical discussions held with National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS) regarding the proposed amendments. Finally, **Section 9** includes the analysis of environmental impacts associated with the proposed action (i.e., proposed amendments) and three alternatives to the proposed action.

This report will be circulated for comment and the proposed SSBPAs will be the subject of a public hearing before the Regional Board. After the public hearing is closed, the Regional Board may adopt the amendments as proposed, make modifications to the proposed amendments (major modifications would require a new public hearing) and adopt, or not adopt the proposed amendments. The public hearing will be noticed according to standard Regional Board protocols. Interested parties are encouraged to comment on the proposed Basin Plan amendments and Staff Report. Regional Board staff will provide written responses to comments received. To assist staff in identifying and responding to comments, please submit written comments in the format suggested in **Appendix A**. If you have any questions concerning the proposed amendments, please contact Mr. Rik Rasmussen at (916) 255-3103.

Following adoption by the Regional Board, the proposed Basin Plan amendments will not become effective until reviewed and approved by the State Board, OAL, and U.S. EPA. The entire review and approval process (from the time Regional Board staff present the proposed amendments to their Board until approved by U.S. EPA) is estimated to be completed by October/November 2003.

2 SUMMARY OF PROPOSED AMENDMENTS TO THE BASIN PLAN

This section of the Staff Report presents the amendment language as it is proposed to appear in the Basin Plan, and provides brief statements defining the intent of the new language added to the Basin Plan via these amendments. Specifically, the amendments proposed in this Staff Report consist of site-specific, numeric water quality objectives for Deer Creek pH and turbidity.

2.1 INTRODUCTION (BASIN PLAN CHAPTER 1)

No modifications to Chapter I (Introduction) of the Basin Plan are proposed.

2.2 EXISTING AND POTENTIAL BENEFICIAL USES (BASIN PLAN CHAPTER II)

No modifications to Chapter II (Existing and Potential Beneficial Uses) of the Basin Plan are proposed.

2.3 WATER QUALITY OBJECTIVES (BASIN PLAN CHAPTER III)

The proposed modifications to water quality objectives consist of site-specific, numeric water quality objectives for Deer Creek pH and turbidity. The specific proposed additions to Section III, p. 6 (pH) and Section III, p. 9 (turbidity) are highlighted and italicized (*highlighted*).

The new Basin Plan language proposed for Deer Creek pH is intended to accomplish two things. First, it is intended to maintain the pH-range component of the existing objective, thereby continuing to prevent controllable factors affecting water quality from causing the creek's pH to be depressed below 6.5 or be raised above 8.5. Second, it is the intent of this site-specific pH objective to eliminate restrictions on pH changes where resultant creek pH falls within the 6.5 to 8.5 range.

The new language added to the Basin Plan for Deer Creek turbidity is intended to accomplish three ends. First, it is intended to provide a new turbidity objective for Deer Creek when the creek's natural (i.e., ambient background) turbidity is between 0 and 5 NTUs *and* the dilution ratio for discharges is less than 20:1 (creek flow to discharge flow). The new objective under these conditions states that the discharge shall not exceed a daily average turbidity of 2 NTUs and a daily maximum turbidity of 5 NTUs. Second, the Basin Plan's existing turbidity objective stating that increases shall not exceed 1 NTU where natural turbidity is between 0 and 5 NTUs shall continue to apply where discharge dilution is greater than 20:1, and natural turbidity is between 0 and 5 NTUs. Third, the Basin Plan's other existing turbidity objectives stating that increases shall not exceed:

- 20 percent when natural turbidity is between 5 and 50 NTUs,
- 10 NTUs when natural turbidity is between 50 and 100 NTUs, and

- 10 percent when natural turbidity is greater than 100 NTUs

will remain applicable to Deer Creek. The Basin Plan's existing turbidity objectives for the three conditions where natural turbidity exceeds 5 NTUs, bulleted above, are not affected by the proposed amendment.

No deletions are proposed to this section of the Basin Plan. A detailed discussion of the rationale and technical information in support of the proposed site-specific objectives is provided in Section 4 of this report, and in technical appendices of this Staff Report.

The following text constitutes **specific pages from the Basin Plan**, with the proposed amendments (*highlighted*).

NOTE THAT ONLY THOSE PORTIONS OF THE BASIN PLAN WITH CHANGES ARE PROVIDED. ROWS OF ASTERISKS (* * * * *) INDICATE WHERE SECTIONS OF TEXT HAVE NOT BEEN INCLUDED.

III. WATER QUALITY OBJECTIVES

The Porter-Cologne Water Quality Control Act defines water quality objectives as "...the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area" [Water Code Section 13050(h)]. It also requires the Regional Water Board to establish water quality objectives, while acknowledging that it is possible for water quality to be changed to some degree without unreasonably affecting beneficial uses. In establishing water quality objectives, the Regional Water Board must consider, among other things, the following factors:

- Past, present, and probable future beneficial uses;
- Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto;
- Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area;
- Economic considerations;
- The need for developing housing within the region;
- The need to develop and use recycled water. (Water Code Section 13241)

The Federal Clean Water Act requires a state to submit for approval of the Administrator of the U.S. Environmental Protection Agency *(USEPA)* all new or revised water quality standards which are established for surface and ocean waters. As noted earlier, California water quality standards consist of both beneficial uses (identified in Chapter II) and the water quality objectives based on those uses.

There are **seven important points** that apply to water quality objectives.

The **first point** is that water quality objectives can be revised through the basin plan amendment process. Objectives may apply region-wide or be specific to individual water bodies or parts of water bodies. Site-specific objectives may be developed whenever the Regional Water Board believes they are appropriate. As indicated previously, federal regulations call for each state to review its water quality standards at least every three years. These Triennial Reviews provide one opportunity to evaluate changing water quality objectives, because they begin with an identification of potential and actual water quality problems, i.e., beneficial use impairments. Since impairments may be associated with water quality objectives being exceeded, the Regional Water Board uses the results of the Triennial Review to implement actions to assess, remedy, monitor, or otherwise address the impairments, as appropriate, in order to achieve objectives and protect beneficial uses. If a problem is found to occur because, for example, a water quality objective is too weak to protect beneficial uses, the Basin Plan should be amended to make the objective more stringent. (Better enforcement of the water quality objectives or adoption of certain policies or redirection of staff and resources may also be proper responses to water quality problems. See the Implementation chapter for further discussion.)

Changes to the objectives can also occur because of new scientific information on the effects of water contaminants. A major source of information is the USEPA which develops data on the effects of chemical and other constituent concentrations on particular aquatic species and human health. Other information sources for data on protection of beneficial uses include the National Academy of Science which has published data on bioaccumulation and the Federal Food and Drug Administration which has issued criteria for unacceptable levels of chemicals in fish and shellfish used for human consumption. The Regional Water Board may make use of those and other state or federal agency information sources in assessing the need for new water quality objectives.

The **second point** is that achievement of the objectives depends on applying them to controllable water quality factors. *Controllable water quality factors* are those actions, conditions, or circumstances resulting from human activities that may influence the quality of the waters of the State, that are subject to the authority of the State Water Board or the Regional Water Board, and that may be reasonably controlled. Controllable factors are not allowed to cause further degradation of water quality in instances where uncontrollable factors have

*** * * * ***

Color

Water shall be free of discoloration that causes nuisance or adversely affects beneficial uses.

Dissolved Oxygen

Within the legal boundaries of the Delta, the dissolved oxygen concentration shall not be reduced below:

> 7.0 mg/l in the Sacramento River (below the I Street Bridge) and in all Delta waters west of the Antioch Bridge; 6.0 mg/l in the San Joaquin River (between Turner Cut and Stockton, 1 September through 30 November); and 5.0 mg/l in all other Delta waters except for those bodies of water which are constructed for special purposes and from which fish have been excluded or where the fishery is not important as a beneficial use.

For surface water bodies outside the legal boundaries of the Delta, the monthly median of the mean daily dissolved oxygen *(DO)* concentration shall not fall below 85 percent of saturation in the main water mass, and the 95 percentile concentration shall not fall below 75 percent of saturation. The dissolved oxygen concentrations shall not be reduced below the following minimum levels at any time:

Waters designated WARM 5.0 mg/l
Waters designated COLD 7.0 mg/l
Waters designated SPWN 7.0 mg/l

The more stringent objectives in Table III-2 apply to specific water bodies in the Sacramento and San Joaquin River Basins:

TABLE III-2
SPECIFIC DISSOLVED OXYGEN WATER QUALITY OBJECTIVES

AMOUNT	TIME	PLACE
9.0 mg/l *	1 June to 31 August	Sacramento River from Keswick Dam to Hamilton City (13)
8.0 mg/l	1 September to 31 May	Feather River from Fish Barrier Dam at Oroville to Honcut Creek (40)
8.0 mg/l	all year	Merced River from Cressy to New Exchequer Dam (78)
8.0 mg/l	15 October to 15 June	Tuolumne River from Waterford to La Grange (86)

* When natural conditions lower dissolved oxygen below this level, the concentrations shall be maintained at or above 95 percent of saturation.

Floating Material

Water shall not contain floating material in amounts that cause nuisance or adversely affect beneficial uses.

Oil and Grease

Waters shall not contain oils, greases, waxes, or other materials in concentrations that cause nuisance, result in a visible film or coating on the surface of the water or on objects in the water, or otherwise adversely affect beneficial uses.

pH

The pH shall not be depressed below 6.5 nor raised above 8.5. Changes in normal ambient pH levels shall not exceed 0.5 in fresh waters with designated COLD or WARM beneficial uses. In determining compliance with the water quality objective for pH, appropriate averaging periods may be applied provided that beneficial uses will be fully protected.

For Goose Lake (2), pH shall be less than 9.5 and greater than 7.5 at all times. *For Deer Creek, source to Cosumnes River, pH shall not be depressed below 6.5 nor raised above 8.5.*

* * * * *

organizations to evaluate compliance with this objective.

The survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality factors shall not be less than that for the same water body in areas unaffected by the waste discharge, or, when necessary, for other control water that is consistent with the requirements for "experimental water" as described in *Standard Methods for the Examination of Water and Wastewater*, latest edition. As a minimum, compliance with this objective as stated in the previous sentence shall be evaluated with a 96-hour bioassay.

In addition, effluent limits based upon acute biotoxicity tests of effluents will be prescribed where appropriate; additional numerical receiving water quality objectives for specific toxicants will be established as sufficient data become available; and source control of toxic substances will be encouraged.

Turbidity

Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases in turbidity attributable to controllable water quality factors shall not exceed the following limits:

- Where natural turbidity is between 0 and 5 Nephelometric Turbidity Units (NTUs), increases shall not exceed 1 NTU.
- Where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent.
- Where natural turbidity is between 50 and 100 NTUs, increases shall not exceed 10 NTUs.
- Where natural turbidity is greater than 100 NTUs, increases shall not exceed 10 percent.

In determining compliance with the above limits, appropriate averaging periods may be applied provided that beneficial uses will be fully protected.

Exceptions to the above limits will be considered when a dredging operation can cause an increase in turbidity. In those cases, an allowable zone of dilution within which turbidity in excess of the limits may be tolerated will be defined for the operation and prescribed in a discharge permit.

For Folsom Lake (50) and American River (Folsom Dam to Sacramento River) (51), except for periods of storm runoff, the turbidity shall be less than or equal 10 NTUs. To the extent of any conflict with the general turbidity objective, the more stringent applies.

For Delta waters, the general objectives for turbidity apply subject to the following: except for periods of storm runoff, the turbidity of Delta waters shall not exceed 50 NTUs in the waters of the Central Delta and 150 NTUs in other Delta waters. Exceptions to the Delta specific objectives will be considered when a dredging operation can cause an increase in turbidity. In this case, an allowable zone of dilution within which turbidity in excess of limits can be tolerated will be defined for the operation and prescribed in a discharge permit.

For Deer Creek, source to Cosumnes River:

- *Where natural turbidity is between 0 and 5 Nephelometric Turbidity Units (NTUs), and the dilution ratio for discharges is less than 20:1, the 1 NTU limitation shall not apply. However, discharges shall not exceed a daily average of 2 NTUs, with a daily maximum of 5 NTUs.*
- *Where natural turbidity is between 0 and 5 NTUs and the discharge dilution ratio is 20:1 or greater, or where natural turbidity is greater than 5 NTUs, the general turbidity objectives stipulated above shall apply.*

* * * * *

2.4 IMPLEMENTATION (BASIN PLAN CHAPTER IV)

No modifications to Chapter IV (Implementation) of the Basin Plan are proposed.

2.5 SURVEILLANCE AND MONITORING (BASIN PLAN CHAPTER V)

No modifications to Chapter V (Surveillance and Monitoring) of the Basin Plan are proposed.

3 BENEFICIAL USES

This section of the Staff Report provides a brief overview of federal and state regulations pertaining to beneficial use designation as part of establishing water quality standards. This section also discusses Deer Creek's past, present, and probable future beneficial uses.

3.1 FEDERAL AND STATE REGULATORY OVERVIEW

Section 303 of the CWA requires that states protect beneficial uses of waters of the United States within their jurisdictional boundaries. U.S. EPA regulations interpret that requirement further to require that states adopt water quality *criteria* (referred to as "*objectives*" in California) that protect the designated "beneficial uses" of water bodies. The designated beneficial uses, the water quality criteria to protect those uses, and an antidegradation policy constitute water quality standards.

A water quality standard defines the water quality goals for a water body, or portion thereof (in part), by designating the beneficial use or uses to be made of the water. States adopt water quality standards to protect public health or welfare, enhance the quality of water, and serve the purposes of the CWA. "Serve the purposes of the Act" (as defined in Sections 101(a)(2) and 303(c) of the CWA) means that water quality standards should, at a minimum:

- provide, wherever attainable, water quality for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water ("fishable/swimmable"); and
- consider the use and value of State waters for public water supplies, propagation of fish and wildlife, recreation, agriculture, and industrial purposes, and navigation (USEPA 1994, p. 2-1).

The CWA requires states to protect "existing uses." Existing uses are defined as those beneficial uses actually attained in the water body on or after November 28, 1975 (40 CFR 131.3(e)).

Beneficial use designation is discussed prior to water quality objectives in this report because water quality objectives are dependent upon the beneficial use designation. Beneficial uses categories established for water bodies within the Sacramento River and San Joaquin River basins are listed and defined in the Fourth Edition of the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins – Central Valley Region (Basin Plan) (RWQCB 1998). Uses that may be protected include, but are not limited to, domestic, municipal, agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation of fish, wildlife, and other aquatic resources or preserves (Water Code Section 13050(f)).

In designating beneficial uses, the Water Code (Section 13241) requires the Regional Board to consider, among other things, the past, present, and probable future beneficial uses of water, environmental characteristics of the hydrographic unit under consideration, including the quality of water thereto, economics, and the water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area.

3.2 Beneficial Uses of Deer Creek

3.2.1 Existing Beneficial Uses

The Basin Plan (RWQCB 1998) states in part:

> *"The beneficial uses of any specifically identified water body generally apply to its tributary streams…"*

Deer Creek is tributary to the Cosumnes River, a "named" water body in the Basin Plan, and the Regional Board has assigned its beneficial uses to Deer Creek. The beneficial uses of the Cosumnes River include: municipal and domestic supply, agriculture (irrigation and stock watering), recreation (contact and non-contact), freshwater habitat (warm and cold), migration (warm and cold), spawning (warm and cold), and wildlife habitat.

3.2.1.1 Aquatic Life Uses

Multiple fish and macroinvertebrate surveys have been conducted to further characterize the freshwater habitat uses of Deer Creek (**Figure 2**). The fish surveys were conducted in August 1993 (JSA), July and September 1994 and in 1995 (CDFG), September and October 1996 (SWRI), and September 1999 (Nature Conservancy/U.C. Davis). The macroinvertebrate surveys were conducted in April 1998 (CDFG) and October 2000 (BioAssessment Services).

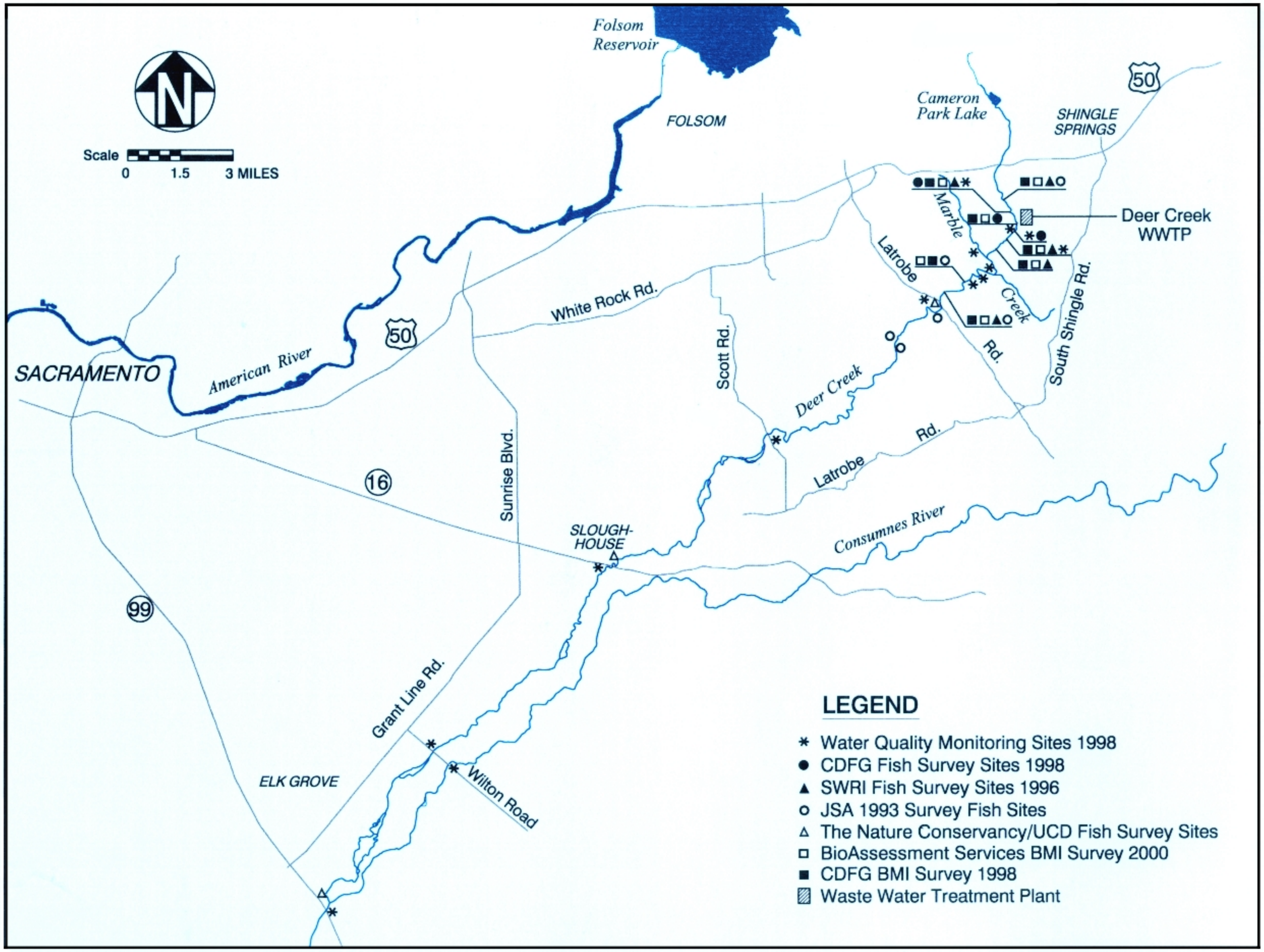


Figure 2. Location of fish and benthic macroinvertebrate survey sites and water quality monitoring sites in Deer Creek, El Dorado and Sacramento Counties, California.

3.2.1.1.1 Fish Communities

The results of the fish surveys are summarized in **Table 1**. Results of the CDFG 1995 survey were not quantified in a report and, therefore, were not included in the summary provided below.

The past fish surveys (Table 1) show that all fish species documented upstream of the DCWWTP also occur downstream of the plant. Based on the results of these surveys, Deer Creek supports a greater number of fish species downstream of the DCWWTP than upstream. As shown by the fish community data presented in Table 1, bluegill are common above and below the DCWWTP.

Table 1. Summary results from Deer Creek fish surveys, El Dorado and Sacramento Counties, California.

Fish Species	Upstream of DCWWTP		Downstream of DCWWTP	
	Survey Documenting Presence	**Relative Abundance** [b]	**Survey Documenting Presence**	**Relative Abundance** [b]
Bluegill	CDFG (1994) SWRI (1996) Conservancy (1999)	abundant abundant common	JSA (1993) CDFG (1994) SWRI (1996) Conservancy (1999)	abundant a abundant common
California roach	JSA (1993) CDFG (1994) SWRI (1996) Conservancy (1999)	abundant abundant abundant abundant	CDFG (1994)	a
Green sunfish	CDFG (1994) SWRI (1996)	a common	JSA (1993) SWRI (1996) Conservancy (1999)	rare common common
Hardhead			SWRI (1996)	abundant
Mosquitofish	SWRI (1996)	common	JSA (1993) SWRI (1996)	common abundant
Prickly sculpin			JSA (1993) SWRI (1996) Conservancy (1999)	common common common
Rainbow trout	CDFG (1994)	a	CDFG (1994)	a
Sacramento pikeminnow			JSA (1993) CDFG (1994) SWRI (1996) Conservancy (1999)	abundant a abundant abundant
Sacramento sucker			JSA (1993) SWRI (1996) Conservancy (1999)	abundant abundant common
Lower Deer Creek Near Confluence with Cosumnes River (Conservancy 1999 survey only)				
Black bullhead				rare
Golden shiner				common
Lamprey				rare
Largemouth bass				rare
Logperch				rare
Smallmouth bass				common

[a] Sampling was not conducted in a manner conducive to estimating relative abundance.

[b] The terms “abundant”, “common”, and “rare” refer to the frequency with which the species were captured during surveys: Abundant = frequently captured; common = commonly captures; and rare = rarely captured.

The abundance of other introduced species (i.e., green sunfish and mosquitofish) also is similar upstream and downstream of the DCWWTP. The surveys conducted have collectively shown California roach to be abundant upstream, but much less abundant downstream. The reason for their lower abundance downstream is that they are a primary prey species of the Sacramento pikeminnow and green sunfish. The primary predatory species, pikeminnow, is not present upstream. The reduced predation pressure upstream allows for higher abundance of California roach in this reach.

Four fish species native to California – hardhead, prickly sculpin, Sacramento pikeminnow, and Sacramento sucker – have been documented to occur only downstream of the DCWWTP. Hardhead, Sacramento sucker, and Sacramento pikeminnow are very abundant downstream, with the abundance of prickly sculpin being notably lower than the other three species. The low-flow habitats that occur upstream of the DCWWTP, coupled with the large cascade near the plant site which blocks all upstream fish migration, are the primary reasons why these fish species do not occur upstream of the DCWWTP.

In 1994, CDFG staff collected (via electroshocking surveys) one rainbow trout downstream of the DCWWTP on July 1, and two rainbow trout upstream of the DCWWTP on September 6. The origin of these fish (i.e., whether native or introduced) is unknown. Fish surveys conducted (both upstream and downstream of the DCWWTP) in 1993 (JSA), 1995 (CDFG), 1996 (SWRI), and 1999 (Cosumnes River Nature Conservancy/U.C. Davis) did not find any trout, either upstream or downstream of the DCWWTP. However, the other fish species found during the 1994 CDFG survey were consistent with those found in the JSA (1993), CDFG (1995), SWRI (1996), and Nature Conservancy/U.C. Davis (1999) surveys.

Finally, the sampling near the confluence with the Cosumnes River by the Cosumnes River Nature Conservancy/U.C. Davis in 1999 documented that six additional fish species make use of Deer Creek in this lower reach. None of these six species were found by the Conservancy/UCD investigators at or upstream of Latrobe Road, nor were any of these six species documented to occur at or upstream of Latrobe Road by any of the other fish surveys conducted by JSA (1993), CDFG (1994, 95), or SWRI (1996).

Based on available fish data discussed above, current effluent discharges from the DCWWTP do not cause the number of fish species present, or their respective relative abundances to be demonstrably lesser downstream compared to upstream of the DCWWTP.

3.2.1.1.2 Benthic Macroinvertebrate Communities

Benthic macroinvertebrates (BMI’s) are useful indicators of site-specific water quality conditions because they are ubiquitous in aquatic systems, have limited mobility, have short and complex life cycles, and vary in their tolerances to water quality (Barbour et al.

1999). Because benthic macroinvertebrates exploit different niches in the aquatic environment and have distinctly different pollution tolerances, their communities at a given site provide insight into habitat quality, including water quality.

The BMI communities of Deer Creek upstream and downstream of DCWWTP, and within the effluent channel, were characterized following major DCWWTP upgrades in April 1998 by CDFG (CDFG 1998) and in October 2000 by BioAssessment Services (BAS 2001). In these investigations, sites were chosen for sampling within seven distinct riffle habitats – two upstream of the DCWWTP (U1 and U2), one in an undiluted “effluent channel” (EFF), and four downstream of the DCWWTP (D1-D4) (**Figure 3**). The two sites sampled upstream of the DCWWTP were located in Deer Creek’s “main channel” approximately 80m upstream of the access road to the DCWWTP (U1) and approximately 50m upstream of the confluence of Deer Creek and the effluent channel (U2).

Deer Creek’s channel is braided at the DCWWTP site, meaning it flows through three distinct channels under winter/early spring high-flow conditions. The rest of the year, it only flows through the main channel, which is located between the other two channels at the DCWWTP site. Both CDFG (1998) and BAS (2001) sampled the effluent channel (EFF) in addition to Deer Creek’s main channel, above (U1 and U2) and below (D1-D4) the DCWWTP. The effluent channel is the channel of Deer Creek that passes closest to the DCWWTP and, therefore, is the channel into which effluent is initially discharged from the DCWWTP. During the winter and early spring months (e.g., December through April/May), some creek water typically flows into this channel, and thus there is some level of dilution upon effluent entering this channel. Conversely, for the period of about May through November, annually, creek water does not flow into the effluent channel upstream of the discharge point; rather, the creek’s complete flow during these months is restricted to the main channel. Consequently, the benthic macroinvertebrate community residing within the effluent channel is isolated from the rest of the creek, and sustained by undiluted effluent throughout this May through November period. The riffle sampled at the EFF site was located within about 100 meters of the point of effluent discharge to this channel. This information is important to note when interpreting the BMI survey findings.

Finally, four riffles were sampled downstream of the DCWWTP. Site D1 was located approximately 800m downstream of the confluence of the effluent channel and main channel. Site D2 was located about another 800m downstream of the D1 site. Site D3 was located approximately 900m downstream of D2, and site D4 was located approximately 100m upstream of the Latrobe Road bridge (Figure 3).

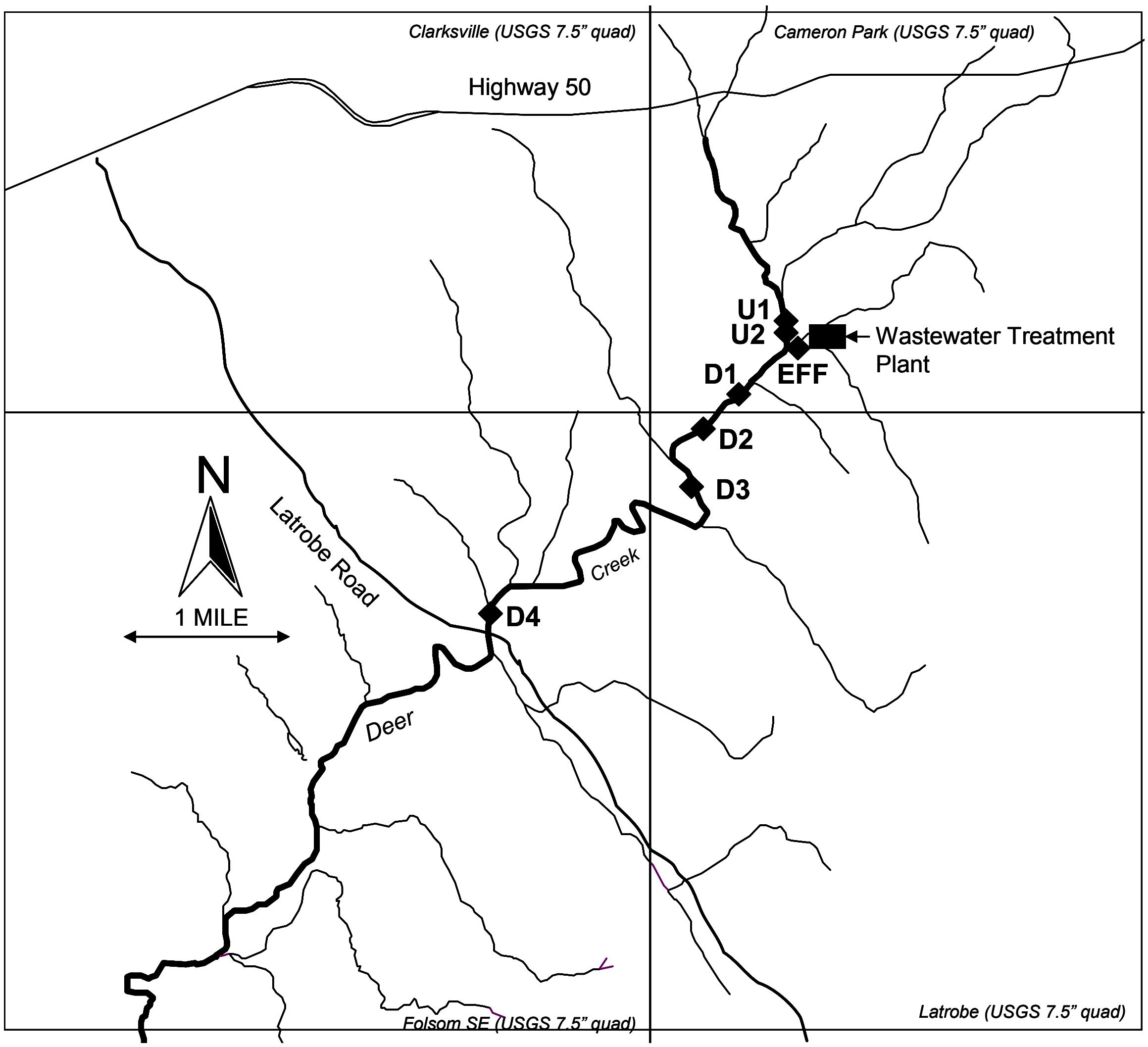


Figure 3. Deer Creek study area and benthic macroinvertebrate sampling sites for CDFG (1998) and BAS (2001), El Dorado and Sacramento Counties, California.

Both the CDFG (1998) and BAS (2000) surveys were performed using the California Stream Bioassessment Procedures (CSBP) for point source assessments (Harrington 1999). The samples were analyzed using a series of metrics, which assign numeric values based on particular attributes of the BMI community. The mean BMI metric values from the CDFG (1998) and BAS (2001) surveys are summarized in **Table 2**. When using these metrics to evaluate overall water quality, metric values for Taxonomic Richness, EPT Taxa richness, EPT Index, and Shannon Diversity are all expected to decrease with water quality impairment. Conversely, metric values for Percent Dominant Taxon and Tolerance Value are expected to increase with water quality impairment.

The results for Taxonomic Richness, EPT Taxa richness, Percent Dominant Taxon, and Shannon Diversity were similar between the two surveys. More importantly, these metrics indicate no downstream or temporal trends of water quality impairment. Scores for EPT Index were consistently higher across all sites for the April CDFG (1998) survey compared to the October BAS (2001) survey suggesting a seasonal effect for this metric. The metric scores for Tolerance Value were consistently higher across all sites for the BAS (2001) survey compared to the CDFG (1998) survey, also suggesting a seasonal effect on community structure. The EPT Index scores reported for both surveys were considerably higher at the downstream sites compared to upstream sites. Moreover, the results of these surveys suggest no downstream trends of water quality impairment resulting from the DCWWTP effluent (Table 2).

The overall heterogeneity in functional feeding group proportions is indicative of a diverse, healthy ecosystem condition at the upstream and downstream sites (**Figure 4**). The results of both surveys indicate a fully functioning community with predators, grazers, filterers, and collectors present at all sites. The fact that shredders were absent at all sites in the BAS (2001) survey (Figure 4) and comprised, on average, only 1% of the functional feeding groups in the CDFG (1998) survey (Figure 4) is likely due to the CDFG's CSBP sampling only riffle habitats. Shredders are dependent on terrestrially derived organic material (i.e., leaves and twigs) as their primary food source and are, therefore, typically found in highest abundance in depositional habitats (i.e., pools) where leaves and woody material settle out and accumulate, and are far less abundant in riffle habitats. Because the CSBP methodology requires that only riffles be sampled, the proportion of shredders is probably under-represented for creeks and streams as a whole. Finally, the BAS (2001) survey found an elevated proportion of collectors in the effluent channel, which was attributed to seasonality of sampling.

To assess potential impacts of the effluent on the benthic macroinvertebrate community, a Morisita-Horn (1966) Index of Similarity value was calculated for all pair-wise comparisons of sites from the CDFG (1998) survey and the BAS (2001) survey (**Table 3**). This value indicates the degree of overlap in the BMI community structure by relative abundance of each taxa present and is calculated as follows:

$$\text{Morisita's } C = \frac{2\sum p_{ij}\, p_{ik}}{\sum p_{ij}^2 + \sum p_{ik}^2}$$

> *"where C is the index of similarity, p_{ij} and p_{ik} are the relative abundance of the i^{th} species in the j^{th} and k^{th} site respectively."*

Values may range from 0 to 1, where 0 indicates no similarity between the communities and 1 indicates perfect similarity between the communities. Low degrees of similarity between upstream and downstream sites would be expected if the effluent water quality was having a negative effect on the stream biota. Conversely, high degrees of similarity suggest that no chronic, negative water quality related impacts to the biota are occurring.

Similarities were high (0.94, 0.99) between the upstream sites in both surveys (Table 3). Comparisons of upstream sites to downstream sites were also relatively high, ranging from 0.67 to 0.92 (mean = 0.79) for the CDFG (1998) survey (Table 3) and from 0.79 to 0.98 (mean = 0.90) for the BAS (2001) survey (Table 3).

Interestingly, the degree of similarity between the BMI communities in the effluent channel and the upstream and downstream sites were relatively high (range = 0.84 to 0.90) for the CDFG (1998) survey, yet were relatively low (range = 0.01 to 0.40) for the BAS (2001) survey (Table 3). The BAS (2001) survey attributed this effect to the fact that their survey was conducted in October, when flows in the creek were low, effluent contributed the only flow for the 5-6 month period preceding the October sampling, and re-colonization due to BMI drift had not occurred during this period of time.

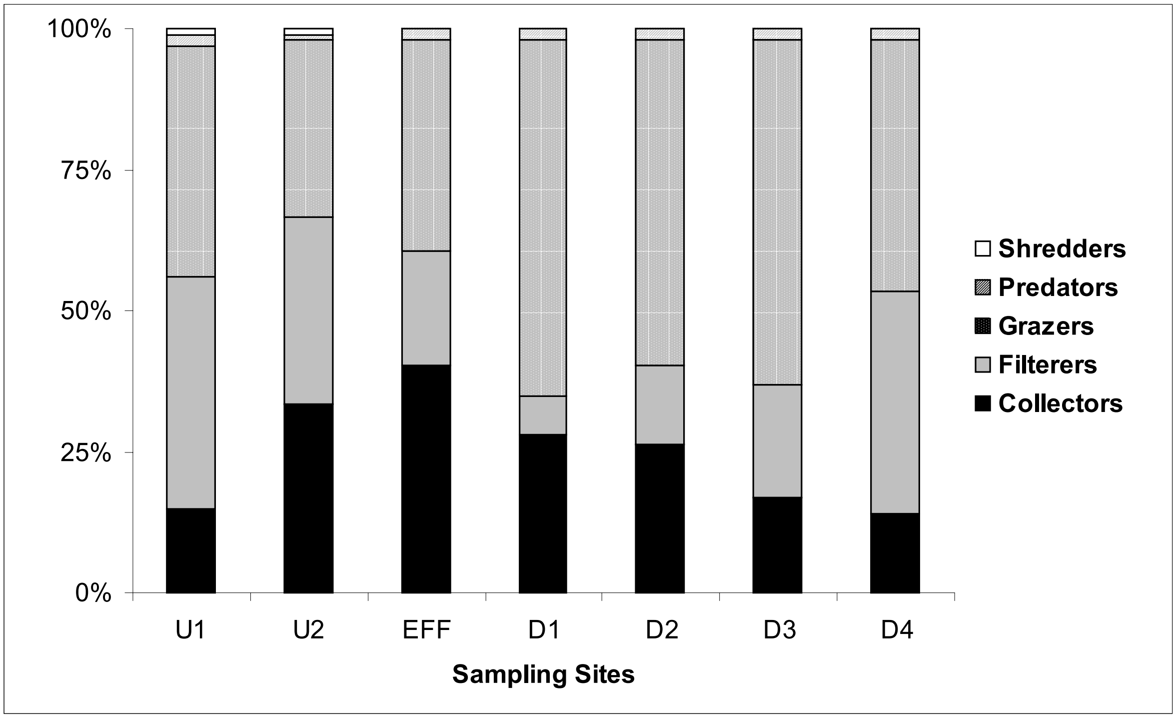
No pH or turbidity effects of the effluent discharge could be identified based on differences in BMI community structured species composition. Upon review of survey findings, the CDFG (1998) investigators reported the following:

> *"The BMI [benthic macroinvertebrate] metrics and similarity index analyses both indicated that the WWTP effluent did not have a large effect on the biotic condition of Deer Creek downstream of the effluent discharge. Even the biotic condition of the effluent channel seemed to be satisfactory when compared to the other sites. The high proportion of the semi-tolerant grazing mayfly, Baetis sp., downstream of the WWTP probably indicated some enrichment in the lower sections of the study area, but cattle grazing in the downstream areas undoubtedly contribute to any downstream enrichment."*

This latter statement, regarding the significance of cattle grazing as a primary source of nutrient enrichment in Deer Creek, is further supported by the fact that *Baetis* sp. was the most dominant taxa at site U1, and the second most dominant taxa at site U2, the two sites surveyed upstream of the DCWWTP. Cattle are grazed both upstream and downstream of the DCWWTP.

In summary, the findings from the fish and BMI surveys provide important insight into how Deer Creek's water quality is affecting it's aquatic resources. Although some differences were observed in communities above and below the DCWWTP, the differences observed were not indicative of degraded water quality below the plant, and specifically cannot be attributed to differences in pH or turbidity regimes above and below the DCWWTP (**Appendix D** and **F**). In fact, diverse, healthy, and fully functional fish and benthic macroinvertebrate communities were documented at sites surveyed both above and below the DCWWTP. Any water quality related effects that the DCWWTP discharge is having on the biotic condition of Deer Creek downstream of the plant is negligible.

A



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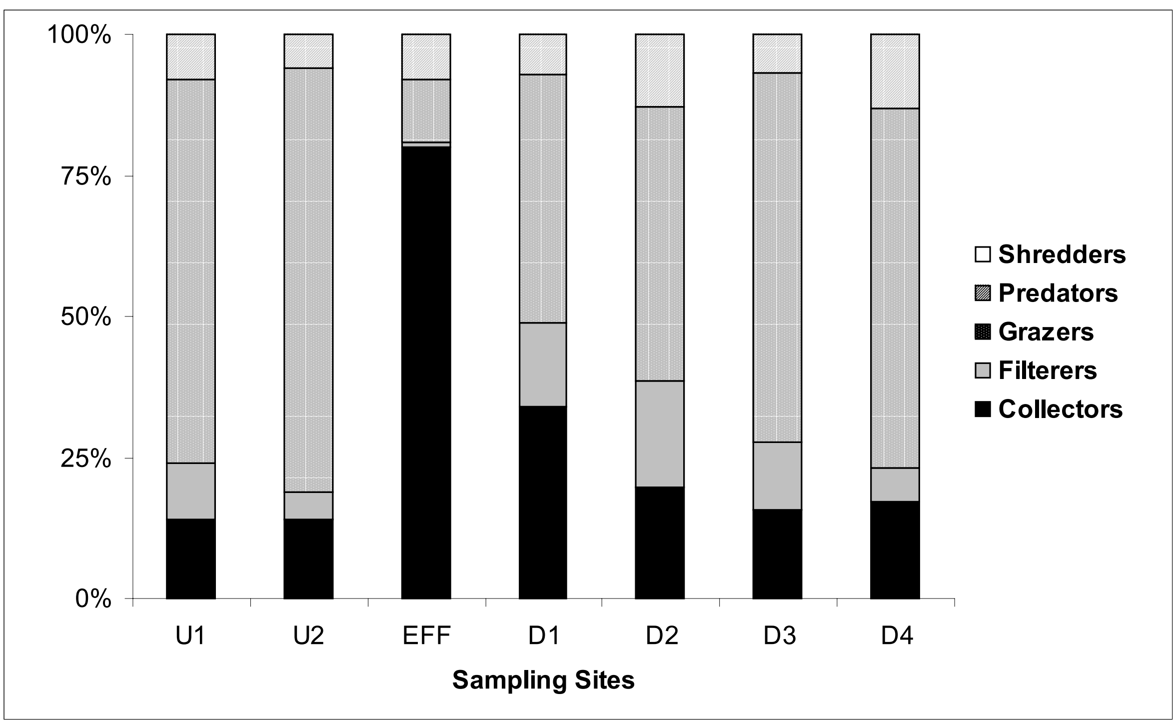

Figure 4. Deer Creek benthic macroinvertebrate functional feeding group proportions, by site, based on data collected from the April CDFG (1998) (A) and October BAS (2001) (B) surveys, El Dorado County, California.

Table 2. Sampling site mean values and coefficients of variation (CV) of metric values and total taxonomic richness for benthic macroinvertebrate assemblages in Deer Creek, El Dorado County, California. Data presented are from surveys conducted by CDFG (1998) in April 1998 and BAS (2001) in October 2000.

Sites:		U1		U2		EFF		D1		D2		D3		D4	
Metric		**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
Taxonomic Richness	CDFG	16	0.22	16	0.26	12	0.34	17	0.06	16	0.11	15	0.12	14	0.08
	BAS	19	0.15	16	0.25	11	0.22	19	0.09	18	0.06	18	0.06	20	0.12
EPT Taxa	CDFG	3	0.22	2	0.35	2	0.25	2	0.25	2	0.00	2	0.25	2	0.25
	BAS	4	0.00	4	0.00	1	0.00	5	0.25	5	0.12	5	0.25	4	0.00
EPT Index	CDFG	37	0.60	30	0.15	36	0.33	64	0.12	60	0.12	64	0.04	55	0.02
	BAS	14	0.55	18	1.15	1	0.87	45	0.49	39	0.33	28	0.84	16	0.34
Percent Dominant	CDFG	54	0.15	41	0.13	44	0.14	61	0.12	56	0.11	60	0.04	51	0.03
Taxon	BAS	65	0.34	69	0.44	53	0.16	43	0.21	44	0.31	57	0.49	50	0.26
Tolerance Value	CDFG	5.1	0.08	5.2	0.16	5.7	0.14	5.6	0.05	5.6	0.04	5.2	0.06	5.2	0.06
	BAS	6.4	0.06	6.4	0.10	6.4	0.06	6.1	0.07	5.9	0.04	6.1	0.08	6.0	0.06
Shannon Diversity	CDFG	1.5	0.07	1.7	0.07	1.4	0.08	1.4	0.13	1.5	0.09	1.4	0.04	1.6	0.03
	BAS	1.5	0.50	1.2	0.71	1.3	0.16	1.8	0.03	1.8	0.10	1.5	0.33	1.9	0.16
		Total		**Total**		**Total**		**Total**		**Total**		**Total**		**Total**	
Taxonomic Richness	CDFG	24		25		22		25		24		22		23	
	BAS	28		22		15		27		27		29		25	
EPT Taxa	CDFG	4		2		3		3		2		3		3	
	BAS	4		4		2		7		5		6		5	

Table 3. Morisita-Horn (1966) similarity index values for all pair-wise comparisons of Deer Creek sites from benthic macroinvertebrate sampling by CDFG (1998) (A) and BAS (2001) (B), El Dorado County, California. Similarity value of 0 indicates no similarity between sites, whereas a value of 1 indicates complete similarity between sites.

A

	U1	**U2**	**EFF**	**D1**	**D2**	**D3**	**D4**
U1	--	0.94	0.86	0.74	0.79	0.85	0.92
U2		--	0.90	0.67	0.71	0.76	0.84
EFF			--	0.84	0.87	0.85	0.88
D1				--	0.99	0.99	0.93
D2					--	0.98	0.95
D3						--	0.98
D4							--

B

	U1	**U2**	**EFF**	**D1**	**D2**	**D3**	**D4**
U1	--	0.99	0.01	0.80	0.88	0.98	0.96
U2		--	0.01	0.79	0.86	0.97	0.94
EFF			--	0.40	0.02	0.02	0.06
D1				--	0.96	0.89	0.87
D2					--	0.95	0.93
D3						--	0.97
D4							--

3.2.1.2 Other Current Beneficial Uses

Other beneficial uses assigned to Deer Creek, beyond aquatic life uses, include municipal and domestic supply (MUN), irrigation and stock watering (AGR), recreation

(REC-1 and REC-2), and wildlife habitat (WILD). With the possible exception of the recreational uses, these other beneficial uses of Deer Creek are not as sensitive to the pH or turbidity of creek waters as are the aquatic life uses. Site-specific pH and turbidity objectives protective of aquatic life uses would, therefore, be fully protective of all other beneficial uses that are less affected by creek pH and turbidity. Hence, no detailed discussion of these other uses is warranted here. With regard to recreational uses, past recreational use surveys conducted by the District's consultants show that hiking, picnicking, wildlife viewing and related REC-2 activities are the primary recreational uses of Deer Creek throughout the year. However, limited contact recreation, possibly including swimming, may occur in the creek.

3.2.2 Past Beneficial Uses

Based on available information and best professional judgment, the beneficial uses of Deer Creek are not believed to have changed since the DCWWTP began discharging effluent to the creek. Rather, only subtle differences in the degree to which various uses are supported is believed to have changed.

U.S. EPA defines "existing uses" as those beneficial uses actually attained in the water body on or after November 28, 1975 (40 CFR 131.3(e)). Uses are considered attainable if they have actually been documented or if conditions conducive to supporting the use have occurred. The DCWWTP began discharging treated municipal effluent to the creek in 1974. Hence, in the interest of providing adequate context for the proposed amendments, this section discusses "past beneficial uses" as those uses of Deer Creek that are believed to have occurred prior to effluent discharges (i.e., prior to 1974).

No documentation of the beneficial uses or the physical, chemical, or biological characteristics of Deer Creek is available for any time prior to 1974. Therefore, past beneficial uses need to be inferred based on best professional judgment regarding the hydrology and water quality of Deer Creek prior to 1974. The Deer Creek watershed has been significantly altered due to urban development, ranching, and other human activities. Hence, Deer Creek hydrology in the 1960s, and early 1970s was already largely impacted by human activities, and has continued to be impacted by such human activities in recent decades.

The past hydrology of Deer Creek during the precipitation period of the year (e.g., November/December through May) probably differed little from the hydrology of Deer Creek today during these months of the year. This is because precipitation-related runoff constitutes the primary source of water to the creek during these months of the year. Conversely, effluent discharges constitute the primary source of water in the creek, downstream of the DCWWTP, during much of the non-precipitation period of the year (SWRCB 1995). As such, creek flows downstream of the DCWWTP would have been substantially lower during much of the summer/fall period, prior to effluent discharges from the DCWWTP. From March 1974 until 1991, a quarry operated upstream from the DCWWTP was permitted to discharge 0.445 MGD. The pump that dewatered the quarry pit was shut off in 1991 and the pit was allowed to fill with water.

The spring at the bottom of the pit was documented to be discharging 200 gallons per minute (GPM) at the time the pump was shut off. The old quarry pit now only discharges into Deer Creek during periods of precipitation.

The lower summer/fall flow rates that occurred prior to 1974 downstream of the plant site would have resulted in fewer downstream miles of wetted habitat and elevated water temperatures in much of the habitat that did exist, relative to current conditions (CDFG 1994; SWRCB 1995). The creek's ability to support aquatic and wildlife communities, riparian communities, recreation, and water supply would have been reduced, relative to existing conditions. Although said beneficial uses may have occurred to a "lesser degree," best professional judgment indicates they, nevertheless, would have existed prior to 1974.

3.2.3 Probable Future Beneficial Uses

Available data and best professional judgment indicate that the probable future beneficial uses of Deer Creek would be the same as the existing beneficial uses, described previously, assuming no changes in upstream hydrology and that current levels of discharge to the creek from the DCWWTP are generally similar in the future.

CALFED, the Cosumnes River Nature Conservancy, NMFS, and others are working cooperatively to improve conditions in the Cosumnes River for fall-run chinook salmon. Specifically, attention is being given to instream flows and removal of low-flow barriers to adult fall-run chinook salmon immigration in the lower reach of the Cosumnes River. Such actions will likely improve upstream immigration and spawning success, of fall-run chinook salmon, in the Cosumnes River. These restoration actions would not affect flows in Deer Creek. Consequently, they would not be expected to substantially change the potential for use of Deer Creek by anadromous salmonids in the future.

4 WATER QUALITY OBJECTIVES

Water quality objectives are established in Basin Plans by the Regional Board to protect beneficial uses. Water quality objectives provide a specific basis for the measurement and maintenance of water quality parameters. The proposed Basin Plan amendments identify site-specific modifications to the general water quality objectives for pH and turbidity for Deer Creek.

Development of water quality objectives requires, at a minimum, consideration of the following elements (Porter-Cologne Water Quality Control Act, Chapter 4, Article 3, Section 13241):

- Past, present, and probable future beneficial uses
- Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto
- Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area
- Economic considerations
- The need for developing housing within the region
- The need to develop and use recycled water

A discussion of each of these elements is provided under the discussion for each water quality objective. A brief history of the development of water quality criteria can be found in **Appendix B**.

4.1 pH OBJECTIVE

4.1.1 Current Basin Plan pH Objective Applicable to Deer Creek

The basin-wide component of the current Basin Plan (RWQCB 1998) pH objective, applicable to Deer Creek, reads as follows:

> *"The pH shall not be depressed below 6.5 nor raised above 8.5. Changes in normal ambient pH levels shall not exceed 0.5 in fresh waters with designated COLD or WARM beneficial uses. In determining compliance with the water quality objective for pH, appropriate averaging periods may be applied provided that beneficial uses will be fully protected."*

4.1.2 Alternatives Considered

For a description of the purpose and need for the proposed Basin Plan amendments, refer to Section 1.1.3 and 4.2.5.1 of this report.

Three alternatives were considered for developing an appropriate water quality objective for Deer Creek pH: 1) no action; 2) adoption of the U.S. EPA national ambient criteria for pH; and 3) adoption of a site-specific pH objective for Deer Creek. The criteria used for selecting the recommended alternative included:

1) consistency with State and federal water quality laws and policies;
2) level of beneficial use protection;
3) consistency with the current science regarding water quality necessary to reasonably protect the beneficial uses; and
4) applicability to Deer Creek a seasonally effluent-dominated water body.

4.1.2.1 Alternative 1 – No Action

Under this alternative, the current Basin Plan water quality objective for pH would remain unchanged and would continue to apply to Deer Creek.

4.1.2.2 Alternative 2 – Adopt U.S. EPA National Ambient Criteria

Under this alternative, the current U.S. EPA national ambient criterion for pH in fresh waters would be applied to Deer Creek as a water quality objective in the Basin Plan. The current national criteria for the protection of freshwater aquatic life and domestic water supplies reads as follows (USEPA 1986, 1999):

> *"Criteria:*
> *Range*
> *5-9 Domestic water supplies (welfare)*
> *6.5-9.0 Freshwater aquatic life*

4.1.2.3 Alternative 3 – Develop a Site-Specific pH Objective

Under this alternative, a site-specific pH objective for Deer Creek, protective of Deer Creek's beneficial uses, would be developed. Its development would consider the current science regarding pH requirements of freshwater aquatic life and site-specific chemical, physical, and biological characteristics of Deer Creek. A thorough discussion of the pH requirements of freshwater aquatic life is provided in Appendix C.

4.1.3 Recommended Alternative

Alternative 3 is the recommended alternative since the action would:

1) be consistent with State and federal water quality laws and policies;
2) facilitate development of an objective that would be protective of Deer Creek's beneficial uses;
3) improve the scientific basis upon which the water quality objective is based; and
4) allow the Regional Board to reasonably address a key regulatory issue associated with Deer Creek pH that is, in large part, a function of the creek being a seasonally effluent-dominated water body.

Adoption of Alternative 1 (No Action) would not result in demonstrable benefits to any of Deer Creek's beneficial uses, and would be inconsistent with the current science regarding pH regulation in ambient waters. Moreover, it would not resolve the current regulatory issue associated with pH for this seasonally effluent dominated water body. The feasibility of implementing this no project alternative is addressed in Section 9.7 below. Alternative 2 (U.S. EPA National Criteria) also offers a viable alternative. However, it would result in a pH objective that is somewhat less restrictive (at the upper end of the range) than the objective developed under Alternative 3, and thus would provide a somewhat lower level of protection to aquatic resources.

4.1.4 Proposed pH Objective

It is proposed that the following language be added to the pH objective section of the Basin Plan (Section III, pg. 6):

> *"For Deer Creek, source to Cosumnes River, pH shall not be depressed below 6.5 nor raised above 8.5."*

It should be noted that this 6.5 to 8.5 range is the same range presently applicable to Deer Creek under the current Basin Plan objective. The only modification proposed is the elimination of the second component of the current pH objective that states: "Changes in normal ambient pH levels shall not exceed 0.5 in fresh waters with designated COLD or WARM beneficial uses."

4.1.5 Basis for and Evaluation of the Site-Specific pH Objective Proposed for Deer Creek

The uses of Deer Creek most sensitive to pH levels are those associated with supporting aquatic life. Appendix C of this Staff Report provides the scientific information that supports the proposed site-specific pH objective developed for Deer Creek. Appendix C provides technical discussions on the following topics:

- typical ambient pH of fresh waters;
- direct effects of pH on aquatic life;
- effects of diurnal fluctuations and rapid pH changes on aquatic life; and
- influence of pH on ammonia toxicity.

The reader is referred to the above-cited sections of Appendix C for a complete discussion of the technical information in support of the proposed site-specific pH objective in terms of its protectiveness of aquatic life uses. In summary, several key points can be made in support of the proposed pH objective.

The majority of surface water bodies throughout the United States have pH values between approximately 6 and 9 pH units, with most of these having a pH between 6.5 and 8.5 (Warren 1971). The pH of most inland fresh waters containing fish ranges from about 6 to 9 (Ellis 1937), with most waters, particularly those with healthy, diverse, and productive fish and macroinvertebrates communities having a pH between approximately 6.5 and 8.5 units (Ellis 1937; McKee and Wolf 1963; FWPCA 1968; USEPA 1973).

The U.S. EPA's current pH criteria for the protection of freshwater aquatic life defines an acceptable ambient pH range (i.e., 6.5-9.0), but does not quantitatively limit the magnitude of rapid change that organisms can be exposed to within this range. This, coupled with the scientific information compiled and discussed in Appendix C of the Staff Report, indicates that the effects of rapid pH changes are insignificant when pH is maintained within the range 6.5 to 8.5.

4.1.5.1 Beneficial Use Considerations

The beneficial uses of Deer Creek were considered in developing the recommended pH objective. The beneficial uses most sensitive to pH are the aquatic life uses. Factors considered that indicate the proposed objective would be protective of these uses are discussed in detail in Appendix C. The proposed site-specific pH objective would be protective of Deer Creek's beneficial uses.

4.1.5.2 Hydrographic Unit Environmental Characteristics Considerations

Adoption of the proposed site-specific pH objective would not affect the hydrology of Deer Creek or downstream water bodies, relative to existing conditions.

4.1.5.3 Water Quality Conditions that could be Reasonably Achieved

Evaluation of available effluent and creek pH data collected following completion of recent DCWWTP upgrades (Appendix D) demonstrates that the pH of the undiluted effluent discharged from the DCWWTP remained between 6.7 and 8.1 units at all times, with effluent pH being between 6.8 and 7.4 more than 95% of the time. The range of effluent pH is not expected to change in the future following possible plant expansion(s). Therefore, current facilities and operations of the DCWWTP would facilitate consistent compliance with the proposed pH objective under both existing and future hydrologic conditions. Resultant pH conditions would be protective of Deer Creek's beneficial uses. No other regulated, point-source discharges potentially affecting Deer Creek pH are known to occur on the creek.

4.1.5.4 Economic Considerations

Current facilities and operations of the DCWWTP would facilitate consistent compliance with the proposed pH objective under existing and anticipated future hydrologic conditions. Therefore, no economic effects are expected to be incurred by the District or any other parties as a result of adopting the proposed pH objective for Deer Creek.

4.1.5.5 Need for Housing

If adopted, the proposed pH objective would have no impact on the need for, or ability to develop, housing in the Deer Creek watershed.

4.1.5.6 Need to Develop and Use Recycled Water

If adopted, the proposed pH objective would not adversely impact the ability to develop and use recycled water in the Deer Creek watershed. In fact, District funds saved by implementing the proposed pH amendment, rather than pursuing Option 1 – Additional Treatment Facilities (see Section 9.7.1), would potentially result in additional funds being made available for development and use of recycled water.

4.2 TURBIDITY OBJECTIVE

4.2.1 Current Basin Plan Turbidity Objective Applicable to Deer Creek

The current Basin Plan (RWQCB 1998) turbidity objective is stated as follows:

> "*Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases in turbidity attributable to controllable water quality factors shall not exceed the following limits:*
>
> - *Where natural turbidity is between 0 and 5 Nephelometric Turbidity Units (NTUs), increases shall not exceed 1 NTU.*
> - *Where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent.*
> - *Where natural turbidity is between 50 and 100 NTUs, increases shall not exceed 10 NTUs.*
> - *Where natural turbidity is greater than 100 NTUs, increases shall not exceed 10 percent.*
>
> *To determine compliance with the above limits, appropriate averaging periods may be applied provided that beneficial uses will be fully protected.*"

4.2.2 Alternatives Considered

Three alternatives were considered for developing an appropriate water quality objective for Deer Creek turbidity: 1) no action; 2) adoption of the U.S. EPA national ambient criteria for turbidity; and 3) adoption of a site-specific turbidity objective for Deer Creek. The criteria used for selecting the recommended alternative included:

1) consistency with State and federal water quality laws and policies;
2) level of beneficial use protection;
3) consistency with the current science regarding water quality necessary to protect the beneficial uses; and
4) applicability to Deer Creek, a seasonally effluent-dominated water body.

4.2.2.1 Alternative 1 – No Action

Under this alternative, the current Basin Plan turbidity objective would remain unchanged and would continue to apply to Deer Creek.

4.2.2.2 Alternative 2 – Adopt U.S. EPA National Criteria

Under this alternative, the current U.S. EPA national ambient criteria for turbidity in fresh waters would be applied to Deer Creek as a water quality objective in the Basin Plan. The current national criteria for solids (suspended and settleable) and turbidity reads as follows (USEPA 1986, 1999):

> *"Criteria:*
>
> *Freshwater fish and other aquatic life:*
>
> *Settleable and suspended solids should not reduce the depth of the compensation point for photosynthetic activity by more than 10 percent from the seasonally established norm for aquatic life."*

4.2.2.3 Alternative 3 –Develop a Site-specific Turbidity Objective

Under this alternative, a site-specific turbidity water quality objective for Deer Creek, protective of beneficial uses, would be developed. Its development would consider the current science regarding turbidity requirements of freshwater aquatic life and site-specific chemical, physical, and biological characteristics of the creek. In addition, turbidity levels protective of other beneficial uses, including aesthetic enjoyment and recreation within and along the creek, would be considered. A thorough discussion of the suspended solids and turbidity requirements of freshwater aquatic life is provided in **Appendix E**.

4.2.3 Recommended Alternative

Regional Board staff recommend Alternative 3, which is to develop a site-specific turbidity objective for Deer Creek. Alternative 3 satisfies the selection criteria since the action would:

1) be consistent with State and federal water quality laws and policies;
2) facilitate development of an objective that would be protective of Deer Creek's beneficial uses;
3) improve the scientific basis upon which the water quality objective is based; and
4) allow the Regional Board to reasonably address a key regulatory issue associated with Deer Creek turbidity that is, in large part, a function of the creek being a seasonally effluent-dominated water body.

Adoption of Alternative 1 (No Action) would not result in demonstrable benefits to any of Deer Creek's beneficial uses, and would be inconsistent with the current science regarding turbidity limits necessary to protect beneficial uses. Moreover, it would not resolve the current regulatory issue associated with turbidity for this seasonally effluent-dominated water body. Alternative 2 (U.S. EPA National Criteria) does not provide a definitive turbidity criterion that could be applied to Deer Creek and, in turn, used in a discharge permit. Moreover, Alternative 2 does not offer a technically applicable approach for developing measurable, and enforceable, compliance criteria for turbidity.

4.2.4 Proposed Turbidity Objective

The scientific literature indicates that freshwater aquatic life is not affected by turbidities within the range of 0 to 5 NTUs (Appendix E). Considering beneficial uses and the need to prevent receiving water limits from being unreasonably more restrictive than effluent limits in NPDES permits for wastewater treatment plants discharging to effluent-dominated water bodies, the following site-specific turbidity objective is proposed for Deer Creek.

It is proposed that the following language be added to the turbidity objective section of the Basin Plan (Section III, pg. 9):

"For Deer Creek, source to Cosumnes River:

- *Where natural turbidity is between 0 and 5 Nephelometric Turbidity Units (NTUs), and the dilution ratio for discharges is less than 20:1, the 1NTU limitation shall not apply. However, discharges shall not exceed a daily average of 2 NTUs, with a daily maximum of 5 NTUs.*
- *Where natural turbidity is between 0 and 5 NTUs and the discharge dilution ratio is 20:1 or greater, or where natural turbidity is greater than 5 NTUs, the general turbidity objectives stipulated above* [i.e., other components of current Basin Plan objective] *shall apply."*

4.2.5 Basis for and Evaluation of the Site-Specific Turbidity Objective Proposed for Deer Creek

4.2.5.1 Regulatory Basis

Currently, the Regional Board includes in its NPDES permits for tertiary wastewater treatment plants, especially those discharging to effluent-dominated water bodies, a turbidity effluent limit of 2 NTUs (daily average)/5 NTUs (daily maximum). The Basin Plan limits the allowable increase in turbidity to 1 NTU when the natural turbidity is between 0 and 5 NTUs. An inconsistency occurs when these two criteria are applied to an effluent-dominated system, such as Deer Creek. For example, Deer Creek's natural turbidity upstream of the DCWWTP is often less than 1 NTU and the flow is frequently 0.6 mgd (1 cfs) or less during the May through November period of the year. If the District were operating to its NPDES permit effluent limits and discharging effluent with a turbidity of 1.8 NTUs at a rate of 2 mgd (3.1 cfs), the downstream creek increase above natural turbidity could be greater than 1 NTU. This would cause an exceedance of the Basin Plan's turbidity objective and the NPDES permit's receiving water limitation for turbidity even though the DCWWTP would be in compliance with the effluent turbidity limitation defined in its NPDES permit, and conditions in the creek would be protective of beneficial uses. The site-specific turbidity objective developed for Deer Creek, a seasonally effluent-dominated water body, resolves this issue.

4.2.5.2 Scientific Basis

The uses of Deer Creek most sensitive to turbidity levels are those associated with aquatic life, contact recreation, and general aesthetic enjoyment. Aesthetic enjoyment and contact recreation are believed to be the uses most sensitive to creek turbidity levels, particularly during the periods of the year when the creek is effluent-dominated.

Under low-flow and turbidity conditions in Deer Creek (i.e. creek turbidity of <1 NTU), the proposed objective would allow daily average turbidity to increase to no more than 2 NTUs, with an instantaneous maximum of 5 NTUs. Differences in creek turbidity levels between 0 and 2 NTUs are difficult to discern with the naked eye. In other words, water having a turbidity of $\leq$2 NTU looks, aesthetically, very similar to water of $\leq$1 NTU when flowing through a creek channel. When Deer Creek's average ambient turbidity is 1-2 NTUs (and dilution ratios are less than 20:1), the proposed objective would be equivalent to the current objective that limits increases to 1 NTU. In cases when Deer Creek's daily average ambient turbidity is between 2 and 5 NTUs (and dilution ratios are less than 20:1), compliance with the proposed objective would either have no effect or would actually reduce daily average receiving water turbidity downstream of the discharge. Under these conditions, no additional increase in the daily average turbidity would be allowed. This is actually more restrictive than the current Basin Plan turbidity objective at these ambient turbidity levels.

The effect of the instantaneous high component of the proposed objective on aesthetic enjoyment would be minimal as well because the frequency with which a 5-NTU condition would occur downstream of the DCWWTP discharge (when the dilution ratio of receiving water to discharge flow is less than 20:1 and natural turbidity is between 0 and 5 NTUs) would be extremely low (**Appendix F**). In fact, it would only be expected to occur under "plant upset" conditions, and would not be expected under normal plant operations and performance. Based on these findings, Regional Board staff believe the proposed turbidity objective would be protective of aesthetic enjoyment of Deer Creek.

The 2/5 NTU limits proposed are consistent with Department of Health Services (DHS) recommendations for effluent turbidity levels that provide adequate effluent disinfection. This, coupled with the aesthetic findings discussed above, indicates that these effluent turbidity levels are protective of downstream recreational uses., and are consistent with turbidity requirements stated in Title 22 CCR for reclaimed water. These effluent turbidity levels are protective of downstream recreational uses.

Appendix E of this Staff Report provides the scientific information that supports the proposed site-specific turbidity objective as being protective of Deer Creek's aquatic life. Appendix E provides extensive technical discussions on the following topics:

- turbidity and suspended solid levels of ambient waters

- effects of turbidity and suspended solids on aquatic life
  - Aquatic Plants
  - Fish
    - mortality resulting from short-term exposures
    - mortality resulting from long-term exposures
    - growth, production, risk of predation and population-level effects
    - minimum effects levels for fish and macroinvertebrates
    - effects of turbidity associated with wastewater discharges
- perspective on turbidity effects on aquatic life from the AFS, and turbidity criteria currently in effect for other western States and Canada

The reader is referred to Appendix E for a complete discussion of the technical information supporting that the proposed turbidity amendment would be protective of Deer Creek's aquatic life beneficial uses.

In summary, several key points can be made in support of the proposed turbidity objective with regard to its ability to protect Deer Creek's aquatic life uses. To aid in interpreting this information, much of which is expressed in terms of total suspended solids (TSS) rather than turbidity, the following relationship between DCWWTP effluent TSS and turbidity is offered. A significant positive relationship has been determined to exist between DCWWTP effluent TSS and turbidity levels (e.g., SWRI 1996). This relationship indicates that the effluent concentration of TSS (in mg/l) is generally about 1.8-2 times the level of turbidity, as expressed as NTU. Hence, on the average, an effluent TSS level of 10 mg/l would correspond to an effluent turbidity of about 5-6 NTUs. It should be noted that this is an average relationship and, therefore, the relationship can vary at specific points in time. Nevertheless, it provides a perspective when interpreting the scientific literature on suspended solids levels, and their effects on aquatic life.

Based on literature available at the time regarding chemically inert suspended solids in waters, that are otherwise satisfactory for the maintenance of freshwater fish, the EIFAC (1965) concluded the following (as presented in USEPA 1973):

- there was no evidence that concentrations of suspended solids less than 25 mg/l have any harmful effects on fish;
- it should usually be possible to maintain good or moderate fish populations in waters that normally contain 25-80 mg/l suspended solids; other factors being equal; however, the yield of fish from such waters might be somewhat lower than from those in the preceding category;
- waters normally containing from 80-400 mg/l suspended solids are unlikely to support good freshwater populations, although freshwater fish may sometimes be found at the lower concentrations within this range; and
- only poor fisheries are likely to be found in waters that normally contain more than 400 mg/l suspended solids.

The U.S. EPA's 1972 water quality criteria document (U.S. EPA 1973) quotes findings from EIFAC (1965). Since the EIFAC issued its report on suspended solids in 1965, numerous additional research articles and technical reports have become available on the topic, including review articles by Hollis et al. (1964), Gammon (1970), Ritchie (1972), Sorensen et al. (1977) and Alabaster and Lloyd (1980). The data provided in these articles support the conclusions drawn in the original EIFAC report (EIFAC 1965). Based on their review of the literature, Alabaster and Lloyd (1980) reiterated the above bulleted statements initially presented by EIFAC (1965) as tentative water quality criteria for suspended solids.

Newcombe and Jensen (1996) performed a "meta-analysis" of 80 published and adequately documented reports on fish responses to suspended sediments, and developed empirical equations that related observed biological responses to duration of exposure and suspended sediment concentration. The empirical data compiled by these authors indicated that long-term exposures (e.g., 4 months or more) to suspended sediments concentrations of approximately 20 mg/l or more would be required before growth rates or fish density would be reduced for juvenile and adult salmonids and freshwater non-salmonids.

Based on its review of Newcombe and Jensen (1996), CDFG technical staff recommended a 30-day average TSS requirement of 10 mg/l be included in the DCWWTP NPDES permit for the period May through October. CDFG staff further stated that, based on findings reported by Newcombe and Jensen (1996), "… *the recommended monthly maximum concentration of 10 mg/l* [TSS] *would alleviate our concerns regarding chronic exposure to TSS.*"

Based on the available technical information briefly discussed above and discussed in greater detail in Appendix E, the proposed site-specific turbidity objective, that would be applicable when natural Deer Creek turbidity is between 0 and 5 NTUs, would be protective of the creek's aquatic life. As such, it would be protective of the creek's aquatic life uses.

In summary, the following can be stated. With few exceptions, available data suggest that implementation of the proposed site-specific amendment under existing conditions would result in the turbidity of Deer Creek, downstream of the DCWWTP, typically remaining below 2 NTUs during the times of the year that the proposed objective would be in effect. This would be true regardless of effluent discharge rates because the proposed amendment applies to the turbidity of the effluent directly. This turbidity condition would be protective of Deer Creek's beneficial uses, including the aquatic life, recreation, and aesthetic enjoyment uses that are most affected by creek turbidity.

With regard to effects on downstream water bodies, monitoring of Deer Creek and Cosumnes River turbidities was conducted during the period February 3, 1998 through March 3, 1998. Turbidity data collected show that the Cosumnes River turbidity levels (immediately above and below the confluence with Deer Creek) were always substantially higher than those of Deer Creek (just downstream of the DCWWTP) at the same time, regardless of Deer Creek flow rates (Appendix F, Figure F-9). Deer Creek water entering the Cosumnes River is not expected to cause a change in turbidity of sufficient magnitude to affect the beneficial uses of the Cosumnes River.

4.2.5.3 Beneficial Use Considerations

Beneficial uses of Deer Creek were considered in developing the recommended site-specific turbidity objective. The beneficial uses most sensitive to turbidity include contact recreation, aesthetic enjoyment,and aquatic life uses. Factors considered that indicate the proposed objective would be protective of these uses are discussed under Section 4.2.5 (above), and in Appendix E of this Staff Report. The proposed site-specific turbidity objective would be protective of Deer Creek's beneficial uses.

4.2.5.4 Hydrographic Unit Environmental Characteristics Considerations

Adoption of the proposed site-specific turbidity objective would not affect the hydrology of Deer Creek or downstream water bodies, relative to existing conditions.

4.2.5.5 Water Quality Conditions that Could be Reasonably Achieved

Evaluation of available effluent and creek turbidity data collected following completion of treatment plant upgrades (Appendix F) demonstrate that current facilities and operations of the DCWWTP would facilitate consistent compliance with the proposed turbidity objective under existing and anticipated future hydrologic conditions. This would be true regardless of effluent discharge rates because the proposed amendment applies to the turbidity of the effluent directly. No other regulated, point source discharges are known to occur along Deer Creek that could potentially affect creek turbidity levels.

4.2.5.6 Economic Considerations

Current facilities and operations of the DCWWTP would facilitate consistent compliance with the proposed site-specific turbidity objective under existing and anticipated future hydrologic conditions. Therefore, no economic effects are expected to be incurred by the District or any other parties as a result of adopting the proposed turbidity objective for Deer Creek.

4.2.5.7 Need for Housing

If adopted, the proposed site-specific turbidity objective would have no impact on the need for, or ability to develop, housing in the Deer Creek watershed.

4.2.5.8 Need to Develop and Use Recycled Water

If adopted, the proposed site-specific turbidity objective would have no impact on the ability to develop and use recycled water in the Deer Creek watershed.

5 ANTIDEGRADATION ANALYSIS

Both the U.S. EPA (40 CFR 131.12) and the State (State Board Resolution No. 68-16) have adopted antidegradation policies as part of their approach to regulating water quality. The Regional Board must assure that its actions do not violate the federal and State antidegradation policies. This section of the Staff Report analyzes whether approval of the site-specific pH and turbidity objectives proposed for Deer Creek would be consistent with the federal and State antidegradation policies.

5.1 FEDERAL ANTIDEGRADATION POLICY

The federal antidegradation policy provides, in part (40 CFR 131.12):

> *"(1) Existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.*
>
> *(2) Where the quality of waters exceed levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water, that quality shall be maintained and protected unless the State finds, after full satisfaction of the intergovernmental coordination and public participation provisions of the State's continuing planning process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located…*
>
> *(3) Where high quality waters constitute an outstanding National resource, such as waters of National and States parks and wildlife refuges and waters of exceptional recreational or ecological significance, that water quality shall be maintained and protected."*

5.2 STATE ANTIDEGRADATION POLICY

Antidegradation provisions of State Board Resolution No. 68-16 ("Statement of Policy With Respect to Maintaining High Quality Waters in California") state, in part:

> *"1. Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water and will not result in water quality less than that prescribed in the policies.*
>
> *2. Any activity which produces or may produce a waste or increased volume or concentration of waste and which discharges or proposes to discharge to existing high quality waters will be required to meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary*

to assure that (a) a pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained."

5.3 Antidegradation Analysis of the Proposed pH and Turbidity Objectives for Deer Creek

5.3.1 pH Objective

The proposed pH objective would not result in a degradation of Deer Creek water quality with respect to water quality currently achieved or provided for in this water body. Moreover, the pH anticipated to be achieved under the proposed objective would differ negligibly from that which would occur when complying with the current Basin Plan objective, as currently regulated. The current pH objective restricts the pH of the creek to the range 6.5 to 8.5 units, which would continue under the proposed objective. The proposed objective would not limit the *change* in pH (due to discharges) to 0.5 units, which occurs under the current Basin Plan objective. The scientific information compiled and discussed in Appendix C of this Staff Report indicate that the effects of rapid pH changes on aquatic life are insignificant when pH is maintained within the range 6.5 to 8.5. This is supported by U.S. EPA's national ambient freshwater criterion for pH, which is 6.5-9.0.

Because the proposed objective would maintain Deer Creek pH within the range 6.5 to 8.5 units, and the scientific literature indicates that within this range, rapid changes in pH are insignificant to aquatic life, no degradation of Deer Creek water quality would occur by approving the proposed amendment. Approval of this site-specific objective would not cause degradation of water quality in any downstream water bodies. Existing instream beneficial uses of Deer Creek, and the level of water quality necessary to protect the existing uses, would be maintained.

In addition, the proposed pH amendment would alleviate the need for costly upgrades to the DCWWTP. To attempt to consistently comply with the current pH objective, a flow metering and chemical-addition pH control system would be designed with the intent to match the effluent pH to the pH of the creek, upstream of the discharge. However, Deer Creek, particularly under low-flow summer conditions, is subject to substantial diurnal fluctuations in pH, occasionally greater than 0.5 pH units. Therefore, it would be necessary to constantly monitor the upstream pH, and adjust the effluent pH accordingly. Chemicals would be added to the effluent (typically NaOH, used to increase effluent pH) in quantities to make the necessary "real-time" effluent pH adjustments in an attempt to prevent downstream creek pH from ever being more than 0.5 pH units different from upstream pH. Such DCWWTP upgrades would not provide demonstrable benefits to any Deer Creek beneficial use. Expanded use of NaOH for effluent pH control would contribute to further increases in TDS levels in Deer Creek and downstream waters, including the Delta. Delta TDS levels already constitute a major water quality concern of Delta water purveyors.

Based on both the socio-economic and scientific findings discussed above, which are supported by this Staff Report, the proposed amendment to the current Basin Plan pH objective is consistent with the maximum benefit to the people of the region and the State. The proposed amendment would not result in water quality less than that prescribed in State water quality policies.

5.3.2 Turbidity Objective

The proposed turbidity objective would not result in a substantial degradation of water quality with respect to that currently achieved in Deer Creek. The turbidity anticipated to be achieved under the proposed objective would differ negligibly from that which would occur when complying with the current Basin Plan objective. When Deer Creek's natural turbidity is between 0 and 5 NTUs, the current Basin Plan objective restricts the change in turbidity (caused by a discharge) to 1 NTU. The Basin Plan also states three other turbidity objectives that are applicable when creek turbidity is between: 1) 5 and 50 NTUs; 2) 50 and 100 NTUs; and 3) greater than 100 NTUs. At all times of the year when natural creek turbidity exceeds 5 NTUs, these three existing Basin Plan turbidity objectives would remain in effect.

Under the proposed site-specific turbidity objective for Deer Creek, the current Basin Plan turbidity objective applicable when natural creek turbidity is between 0 and 5 NTUs would be modified for periods when the dilution ratio of receiving water to discharge flow is less than 20:1. Under these conditions, the turbidity of the discharge would be restricted to 2 NTU (daily average) and 5 NTU (daily maximum). When the dilution ratio of receiving water to discharge flow is greater than 20:1, and natural turbidity is between 0 and 5 NTUs, the increase in turbidity shall not exceed 1 NTU. Under the latter condition described, the proposed objective and the current Basin Plan objective are the same.

Under low-flow and turbidity conditions in the creek (i.e. average creek turbidity of <1 NTU), the proposed objective would allow daily average turbidity to increase to no more than 2 NTUs, with an instantaneous maximum of 5 NTUs. Differences in average turbidity levels between 0 and 2 NTUs are difficult to discern with the naked eye. In other words, water having a turbidity of ≤2 NTU looks, aesthetically, essentially the same as water of ≤1 NTU when flowing through a creek channel. These levels of turbidity are far below levels that could adversely affect any life stage of aquatic life (Appendix E). Average turbidity levels that could occur in Deer Creek under the proposed objective also would be protective of the creek's other beneficial uses, including contact and non-contact recreation and aesthetic enjoyment.

Under conditions when the creek's average ambient background turbidity is greater than 1 NTU, the proposed objective would result in average turbidity increases, due to discharges, being less than 1 NTU. Moreover, in cases when the creek's natural turbidity is between 2 and 5 NTUs, compliance with the proposed amendment by the DCWWTP would result in either no change or a reduction, rather than an increase, in average ambient creek turbidity, downstream of the discharge.

The instantaneous high turbidity of 5 NTUs allowed under the proposed objective would not unreasonably affect Deer Creek's existing or anticipated future beneficial uses. The 5 NTU level is still below levels that could adversely affect any life stage of aquatic life (see Appendix E) and, therefore, is protective of aquatic life uses. The effect of the instantaneous high component of the proposed objective on aesthetic enjoyment is minimal as well because the frequency with which a 5 NTU condition would occur downstream of the DCWWTP discharge (when the dilution ratio of receiving water to discharge flow is less than 20:1 and natural turbidity is between 0 and 5 NTUs) would be extremely low; that is, it would not be expected to occur during normal DCWWTP operations and performance. The 5 NTU component of the proposed objective would be protective of Deer Creek's existing and anticipated future beneficial uses.

Approval of this site-specific objective would not cause degradation of water quality in any downstream water bodies.

In summary, instream beneficial uses of Deer Creek and the level of water quality necessary to protect the existing and anticipated future uses would be maintained upon approval of the proposed site-specific pH and turbidity objectives. Second, the proposed objectives would alleviate the need for costly chemical-addition and filtration upgrades to the DCWWTP (see Section 9.7 of this Staff Report), which would not provide benefits to beneficial uses. Based on these findings, the proposed site-specific pH and turbidity objectives for Deer Creek are consistent with the maximum benefit to the people of the region and the State. Finally, the proposed site-specific objectives for Deer Creek would not result in water quality less than that prescribed in State water quality policies.

6 ENDANGERED SPECIES ACT CONSIDERATIONS

6.1 OVERVIEW AND BACKGROUND

The U.S. EPA has final approval authority for Basin Plan amendments. U.S. EPA's approval of new and revised state water quality standards is a federal action subject to the consultation requirements of Section 7(a)(2) of the ESA (65 FR 24647 (April 27, 2000)). Section 7(a)(2) of the ESA states that each federal agency shall ensure that any action authorized, funded, or carried out by such agency is *not likely to jeopardize the continued existence* of any endangered or threatened species or result in *destruction or adverse modification* of designated critical habitat. Although consultation under the ESA is U.S. EPA's obligation, the U.S. EPA and the states acknowledge that states can assist U.S. EPA in fulfilling its ESA obligations and have a role in assuring that state standards adequately protect aquatic life and the environment, including threatened and endangered species (65 FR 24643).

This section of the Staff Report has been prepared to assist the U.S. EPA in meeting its obligations under Section 7(a)(2) of the ESA as part of its action to approve the proposed Deer Creek SSBPAs. To assist the U.S. EPA, Regional Board staff have met with both NMFS and the U.S. Fish and Wildlife Service (USFWS) regarding the proposed amendments, and have, where appropriate, incorporated input from these agencies directly into the site-specific water quality objectives proposed for Deer Creek. The technical discussions held, direct incorporation of NMFS and USFWS input into the proposed amendments, and the information presented and discussed in this section of the report are intended to facilitate and expedite the U.S. EPA's ESA obligations pertaining to the Proposed Action (i.e., U.S. EPA approval of site-specific pH and turbidity objectives for Deer Creek). The proposed site-specific objectives for Deer Creek pH and turbidity are stated in Sections 4.1.4 and 4.2.4, respectively.

6.2 NMFS ESA CONSIDERATIONS

NMFS has regulatory jurisdiction over anadromous salmonids, and is the agency responsible for listing steelhead as threatened under the federal ESA. Central Valley steelhead was listed as a federally threatened species under the federal ESA (63 FR 13347 (March 19, 1998, effective May 18, 1998)). Subsequent to that listing, NMFS promulgated its Final Rule defining critical habitat for steelhead in the Central Valley of California "Evolutionary Significant Unit" (ESU) on February 16, 2000 (65 FR 7764). Deer Creek and the Cosumnes River are included in the critical habitat designated for Central Valley steelhead.

In promulgating the critical habitat designation, NMFS was clear to point out that the available information allowed it only to characterize "basin-level designations," and that it cannot yet "…*depict salmonid habitats in a consistent manner or at a fine geographic scale…*" (65 FR 7767). Consequently, although NMFS has stated its preference to identify critical habitat by designating specific areas accessible to the species within the range of hydrologic units within each ESU, the watershed-based description does not provide "…*the level of resolution to define the species' presence or absence in specific local creeks and streams*…" (65 FR 7767).

The proposed site-specific pH and turbidity objectives for Deer Creek were developed cooperatively by staff from the Regional Board, CDFG, NMFS, USFWS, and the District and the District's consultant. As part of this collaborative process, ESA technical discussions were held with NMFS to assist NMFS and the U.S. EPA in assessing whether the Proposed Action is likely to have an adverse effect on the Central Valley steelhead or its critical habitat.

Steelhead spawn in the winter months (primarily January through March) when water temperatures are cold and instream flows are typically high. In addition, juvenile steelhead have been found to emigrate from systems when water temperatures rise above levels suitable for continued in-river rearing. Although there is no evidence that steelhead occur in Deer Creek, NMFS staff have suggested that steelhead can make opportunistic use of various water bodies within the Central Valley, even warmwater bodies, under very specific hydrologic and water temperature conditions (e.g., cold, high-flow conditions of winter and spring months). In other words, NMFS staff have raised the possibility that adult steelhead could immigrate into a water body such as Deer Creek under high-flow conditions during the spawning season, assuming no barriers to adult immigration exist, spawn, and have juvenile fish rear in the creek until water temperatures reached levels that trigger a behavioral response to emigrate from the creek in search of colder waters. As a general agency position, however, NMFS has concluded that *"…few if any effects would result from an activity where it is well documented that the listed species makes little use of a river reach or basin and the existing habitat conditions are poor*." (65 FR 7767).

Following discussions at a Deer Creek SSBPA technical meeting held in June 2000, NMFS staff engaged in subsequent technical discussions pertaining to steelhead and the Deer Creek SSBPA process. Specifically, NMFS staff indicated that they must assure that the proposed SSBPAs for Deer Creek would not:

1) result in "take," as defined under Section 9 of the ESA;
2) jeopardize the continued existence of the species and/or adversely modify designated critical habitat; or
3) eliminate the potential for steelhead to opportunistically use Deer Creek and the Cosumnes River under certain hydrologic and water temperature conditions.

Although NMFS staff stated them separately, these three concerns are interrelated. As NMFS has stated, "…*actions satisfying the standard for adverse modification are nearly always found to also jeopardize the species concerned, and the existence of a critical habitat designation does not materially affect the outcome of the section 7 consultation*."

(65 FR 7771-72) According to NMFS, the threshold to find “adverse modification” is not lower than the threshold necessary to find “jeopardy” (65 FR 7772).

In addition, NMFS’s third point, with regard to protection of opportunistic use, was identified by NMFS as a specific management objective relevant to the issues it raised concerning the ESA (see 65 Fed. Reg. at 7776 regarding special management considerations).

Based on available site-specific data (Appendices C-F), this section specifically addresses NMFS ESA issues (enumerated above) regarding steelhead within the context of the Proposed Action – approval of site-specific water quality objectives for Deer Creek pH and turbidity.

6.2.1 Existing and Post-Action Conditions of Deer Creek and the Cosumnes River

Existing conditions of Deer Creek, including pH and turbidity conditions, support healthy and diverse aquatic communities both upstream and downstream of the DCWWTP (see Section 3.2.1 of this Staff Report). For example, in April 1998, the CDFG’s Aquatic Bioassessment Laboratory surveyed the benthic macroinvertebrates of Deer Creek using the California Stream Bioassessment Procedures. In its survey report (CDFG 1998), CDFG stated the following:

> *“The BMI* [benthic macroinvertebrate] *metrics and similarity index analyses both indicated that the WWTP effluent did not have a large effect on the biotic condition of Deer Creek downstream of the effluent discharge. Even the biotic condition of the effluent channel seemed to be satisfactory when compared to the other sites.”*

A subsequent survey conducted by BAS (2001) made similar findings.

The site-specific pH and turbidity objectives developed for Deer Creek would be protective of Deer Creek’s resident aquatic biota. Those objectives also would be protective of steelhead, in the event that this species would make opportunistic use of the creek under certain hydrologic and water temperature conditions.

Once the proposed site-specific amendments become effective, daily and seasonal levels for Deer Creek pH and turbidity and other water quality parameters would not be expected to change, relative to existing conditions. This is because none of the factors/land use practices affecting creek water quality upstream of the DCWWTP would be expected to change following approval of the amendments. Similarly, facilities and operations at the DCWWTP would not change, relative to existing conditions. Consequently, Deer Creek water quality downstream of the DCWWTP would not change, relative to existing conditions, as a result of the Proposed Action. Because the Proposed Action would not cause a change in the water quality of Deer Creek, it similarly could not affect the water quality of the Cosumnes River to which Deer Creek is tributary. Also, as discussed in Section 9.5.4 of this Staff Report, the DCWWTP discharges, and in fact Deer Creek itself, typically has little, if any, effect on Cosumnes River pH and turbidity – the water quality parameters affected by the Proposed Action.

Possible future expansion of the DCWWTP, to accommodate planned and approved growth in the region, could result in additional effluent discharges to Deer Creek during some periods of the year. Expansion of the existing recycled water program could maintain current discharge levels to the creek in some months, even with an expanded plant. Hence, future changes to downstream hydrology/water quality would primarily be dependent upon changes to current facilities and/or operations of the DCWWTP to accommodate planned and approved growth. Possible future expansion(s) and modified operations of the DCWWTP would be regulated through the NPDES permit and the CEQA environmental review process (for expansion). Any possible future expansion(s) of the DCWWTP would undergo separate CEQA environmental review and ESA consultation, as required.

Once the proposed Basin Plan amendments are approved by the U.S. EPA and become effective, Regional Board permitting staff intend to reopen the NPDES permit for the DCWWTP (RWQCB Order No. 99-130, (NPDES Permit No. CA 0078662) and revise the receiving water limitations for pH and turbidity to make them consistent with the site-specific Basin Plan objectives for Deer Creek. No changes in DCWWTP facilities or operations would be triggered by the proposed Basin Plan amendments becoming effective or from NPDES permit revisions related to amendment approval.

6.2.2 NMFS Steelhead ESA Issues

As identified above, NMFS staff indicated that issues for NMFS under the ESA are whether U.S. EPA's approval of the proposed site-specific pH and turbidity objectives for Deer Creek would: 1) cause "take" of steelhead; 2) jeopardize the continued existence of the species or adversely modify critical habitat; or 3) reduce/eliminate the potential for steelhead to opportunistically use Deer Creek. As discussed above, these three issues are interdependent. Each of these issues is directly addressed below.

6.2.2.1 ESA Section 9 "Take"

Under the ESA, it is illegal to "take" a listed species without a permit or other authorization 16 U.S.C. § 1538(a). There can be a "take" of a species through habitat modification only to the extent that such modification results in the actual killing or injury to a member of the species (*Babbitt v. Sweet Homes Chapter of Communities for a Greater Oregon*, 515 U.S. 687 (1995)). Because approval and implementation of the Proposed Action would not cause a change in the hydrology or water quality of Deer Creek, relative to existing conditions, such approval and implementation would not cause or increase the risk for "take" of steelhead.

6.2.2.2 Jeopardy/Critical Habitat

In its Final Rule on critical habitat published in the Federal Register, and as stated above, NMFS stated the following with regard to steelhead:

"In streams where there is limited species distribution information, NMFS biologists would make their best professional judgment about the access to and suitability of available habitat and what if any impacts would occur to the listed fish as a result of a specific activity. Few if any effects would result from an activity where it is well documented that the listed species makes little use of a river reach or basin and the existing habitat conditions are poor" (65 FR 7767).

With regard to the Proposed Action, all available evidence demonstrates that there would be no impacts to the steelhead as a result of the action. This conclusion is based on two fundamental findings. First, steelhead have not been documented in Deer Creek. Second, approval and implementation of the Proposed Action would not cause a change in the hydrology or water quality of Deer Creek, relative to existing conditions.

6.2.3 Conclusions

Based on collaborative development among the parties, including direct input from NMFS, and the findings stated above, it can be concluded that implementation of the Proposed Action would not jeopardize the continued existence of Central Valley steelhead, nor would it destroy or adversely affect critical habitat designated for the species.

6.3 USFWS ESA CONSIDERATIONS

The USFWS has regulatory jurisdiction over all species listed under the federal ESA other than anadromous salmonids, which fall under the jurisdiction of NMFS. Moreover, the proposed federal action, for which consultation with USFWS is being conducted, is approval of site-specific pH and turbidity objectives for Deer Creek. In the event that a listed plant, amphibian, reptile, or other species for which USFWS has jurisdiction were to use Deer Creek and/or its riparian corridor, U.S. EPA's action of approving the proposed site-specific water quality objectives for Deer Creek would not adversely affect the species, based on the scientific information compiled and contained within this Staff Report. This is primarily because the proposed amendments would not affect creek hydrology, nor would they change water quality by magnitudes that could affect these organisms. The proposed amendments were cooperatively developed by Regional Board, CDFG, NMFS, USFWS, and District staff and the District's consultant to be protective of Deer Creek's beneficial uses.

Possible future expansion of the DCWWTP, to accommodate planned and approved growth in the region, could result in additional effluent discharges to Deer Creek during some periods of the year. Expansion of the existing recycled water program could maintain current discharge levels to the creek in some months, even with an expanded DCWWTP. Hence, future changes to downstream hydrology/water quality would primarily be dependent upon changes to current facilities and/or operations of the DCWWTP to accommodate planned and approved growth. Possible future expansion(s) and modified operations of the DCWWTP would be regulated through the NPDES permit and the CEQA environmental review process (for expansion). Any possible future expansion(s) of the DCWWTP will undergo separate CEQA environmental review and ESA consultation, as required.

7 PROGRAMS FOR IMPLEMENTATION OF SITE-SPECIFIC OBJECTIVES

The Porter-Cologne Water Quality Control Act states that Basin Plans consist of beneficial uses, water quality objectives, and a program of implementation for achieving their water quality objectives (Water Code Section 13050(j)). Water Code Section 13242 prescribes the necessary contents of a program of implementation, which includes:

1) a description of the nature of the actions that are necessary to achieve the water quality objectives, including recommendations for appropriate action by any entity, public or private;
2) a time schedule for the actions to be taken; and
3) a description of surveillance to be undertaken to determine compliance with the objectives.

Each of these requirements is discussed separately below.

7.1 Actions Necessary to Achieve the Proposed Water Quality Objectives

Deer Creek is effluent-dominated downstream of the DCWWTP during most of the low-flow period of the year (e.g., June through November). As stated in Chapter IV (Implementation) of the Basin Plan, municipal point source discharges to surface waters are generally controlled through NPDES permits. Although the NPDES program was established by the CWA (Section 402), the permits are prepared and enforced by the Regional Board per California's authority for the Act. Discharges to Deer Creek from DCWWTP are regulated under a NPDES permit issued by the Regional Board (Order No. 99-130, NPDES No. CA0078662).

7.1.1 pH

Upon the proposed pH amendment for Deer Creek becoming effective, no specific actions would be necessary to achieve the site-specific objective. Continued operation of the DCWWTP in a manner similar to current operations, and consistent with its applicable NPDES permit, would result in achievement of the proposed pH objective for Deer Creek. This situation would not change if the DCWWTP is expanded to meet projected, build-out conditions, because even the undiluted effluent would achieve the proposed pH objective. The pH of the final treated effluent has historically been between 6.5 and 8.5 pH units (see Appendix D).

7.1.2 Turbidity

Upon the proposed turbidity objective for Deer Creek becoming effective, no specific actions would be necessary to achieve this site-specific objective. Continued operation of the DCWWTP in a manner similar to current operations, and consistent with its applicable NPDES permit, would result in achievement of the proposed turbidity objective for Deer Creek. Moreover, achievement of the proposed turbidity objective is expected if the DCWWTP is expanded in the future.

7.2 Time Schedule for Compliance

Because compliance with the proposed site-specific objectives for Deer Creek pH and turbidity presently occurs, and is expected to continue to occur in the future, no schedule for compliance with the proposed site-specific water quality objectives needs to be developed.

7.3 Monitoring and Surveillance Program

To comply with Water Code Section 13242, a Monitoring and Surveillance Program would be implemented at the time the proposed Basin Plan amendments are approved by U.S. EPA and thus become effective. For additional detail about this Program, see Section 8 of this Staff Report.

8 MONITORING AND SURVEILLANCE PROGRAM

This section contains a description of the monitoring and surveillance activities to be undertaken by the Regional Board and the District. Monitoring and surveillance includes monitoring by the District, monitoring and investigations by the Regional Board, and surveillance and inspections by the Regional Board. Acquisition of data is a basic need of a water quality control program, and is required by both the federal CWA and the Porter-Cologne Water Quality Control Act.

8.1 PROPOSED ACTIVITIES

8.1.1 Discharger Monitoring

8.1.1.1 Water Quality Monitoring

The District operates the DCWWTP under Regional Board Order No. 99-130 (NPDES No. CA 0078662). This Order includes a Monitoring and Reporting Program, which requires the District to monitor Deer Creek pH and turbidity, weekly, at the R1 (upstream) and R2 (downstream) monitoring sites. The District also monitors effluent pH and turbidity continuously. This monitoring currently occurs, and would continue as long as the District discharges treated municipal wastewater to Deer Creek. Consequently, a program is already in place for monitoring Deer Creek pH and turbidity to assess the ability of the District's DCWWTP to comply with the proposed amendments for these parameters in this water body.

8.1.1.2 Biological Monitoring

In addition to conducting water quality monitoring weekly (see above), the District has agreed to fund the conducting of biological assessments of Deer Creek's BMI community (using CDFG's CSBP) twice/year (spring and fall) for two years (total of four surveys). The District's commitment to fund these surveys constitutes a "monitoring component" of the Proposed Action.

The CDFG April 1998 survey (CDFG 1998), coupled with a survey conducted during the fall of 2000 (BAS 2001), will be used to characterize existing conditions. Subsequent BMI surveys, following U.S. EPA approval of the proposed amendments and associated revisions to the receiving water pH and turbidity limits in the NPDES permit, would provide additional biological data to characterize the relative health of the aquatic community over time. The details of these surveys (i.e., exact timing, sites to be surveyed, etc.) will be determined through future meetings of District, Regional Board, and CDFG staff, following approval of the proposed amendments by U.S. EPA.

8.1.2 Regional Board Surveillance and Inspection

Regional Board surveillance and inspection activities for Deer Creek, a seasonally effluent-dominated water body, would include those currently being conducted under the NPDES Program. These would include, but not be limited to, the following activities:

1) inspections of the DCWWTP facilities, operations, and records;
2) inspections of the physical, chemical, and biological characteristics of Deer Creek upstream and downstream from the DCWWTP; and
3) review of discharger-submitted self monitoring reports.

In addition, the Regional Board will continue to conduct compliance monitoring to determine permit compliance and validate self-monitoring reports. Discharger compliance monitoring is the responsibility of the Regional Board staff.

Finally, Regional Board staff would conduct investigations of complaints, if any are made to the Regional Board. Complaints from public or governmental agencies to the Regional Board regarding the discharge of pollutants or creation of nuisance conditions would be investigated and pertinent information collected.

8.2 USE OF MONITORING DATA

Monitoring data collected would be used to: 1) determine whether the proposed site-specific water quality objectives for Deer Creek are being achieved; 2) characterize resultant instream conditions, both chemical and biological, under the site-specific water quality objectives; and 3) assess the relative health of Deer Creek's aquatic ecology and other beneficial uses in the near-term and future.

9 ENVIRONMENTAL IMPACT REVIEW

9.1 INTRODUCTION

The planning process for Basin Plans has been certified by the Secretary of Resources as a regulatory program pursuant to Public Resources Code section 21080.5, and, California Environmental Quality Act (CEQA) Guidelines § 15251(g). Pursuant to Public Resources Code section 21080.5(c), the Basin Plan planning process is exempt from the provisions of the CEQA that relate to preparation of Environmental Impact Reports and Negative Declarations. This chapter satisfies the requirements of State Board regulations for *Implementation of CEQA, Exempt Regulatory Programs*, which are found in the California Code of Regulations, Title 23, Division 3, Chapter 27, Article 6, beginning at section 3775. Section 3777 requires preparation of:

- an environmental checklist; and
- a written report containing a brief description of the proposed activity or project, reasonable alternatives to the proposed activity, and mitigation measures to minimize any significant adverse environmental impacts of the proposed activity.

9.2 PROPOSED PROJECT

Site-specific amendments of the existing Basin Plan are being sought by the Regional Board, with support from the California Department of Fish and Game (CDFG) and the El Dorado Irrigation District (District). In addition, technical meetings were held with the NMFS, USFWS, and U.S. EPA to help guide the development of the proposed amendments. Amendments to the Basin Plan are made by the Regional Board pursuant to Water Code section 13240 using a structured process involving scientific peer review, full public participation, state environmental review, and state and federal agency review and approval. In this case, the Proposed Project is approval of proposed site-specific water quality objectives for Deer Creek pH and turbidity that would be protective of Deer Creek's beneficial uses.

Compliance with the proposed site-specific pH and turbidity amendments to the Basin Plan would not result in any changes in Deer Creek pH or turbidity, relative to pH and turbidity conditions that currently exist in Deer Creek.

The proposed amendment would result in the following changes from the current Basin Plan requirements for pH and turbidity.

pH:
<u>Current Basin Plan Objective</u>: "*The pH shall not be depressed below 6.5 nor raised above 8.5. Changes in normal ambient pH levels shall not exceed 0.5 in fresh waters with designated COLD or WARM beneficial uses*."

Proposed Site-specific Objective: "*For Deer Creek, source to Cosumnes River, pH shall not be depressed below 6.5 nor raised above 8.5.*"

The change is dropping the "0.5-unit change" component of the current objective.

Turbidity:
Current Basin Plan Objective: *"Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases in turbidity attributable to controllable water quality factors shall not exceed the following limits:*

- *Where natural turbidity is between 0 and 5 Nephelometric Turbidity Units (NTUs), increases shall not exceed 1 NTU.*
- *Where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent.*
- *Where natural turbidity is between 50 and 100 NTUs, increases shall not exceed 10 NTUs.*
- *Where natural turbidity is greater than 100 NTUs, increases shall not exceed 10 percent.*

Proposed Site-specific Objective: "*For Deer Creek, source to Cosumnes River:*

- *Where natural turbidity is between 0 and 5 Nephelometric Turbidity Units (NTUs), and the dilution ratio for discharges is less than 20:1, the 1NTU limitation shall not apply. However, discharges shall not exceed a daily average of 2 NTUs, with a daily maximum of 5 NTUs.*
- *Where natural turbidity is between 0 and 5 NTUs and the discharge dilution ratio is 20:1 or greater, or where natural turbidity is greater than 5 NTUs, the general turbidity objectives stipulated above shall apply."*

The change does not affect the last three of four turbidity objectives of the current Basin Plan (i.e., objectives applicable when natural receiving water turbidity exceeds 5 NTUs). The change affects only the first of those four turbidity objectives, which applies when receiving water turbidity is between 0 and 5 NTUs. Under these conditions, the current objective limits creek turbidity increases to 1 NTU or less. Under the proposed amendments, the objective would instead provide that when the receiving water to discharge dilution ratio is less than 20:1, the daily average turbidity cannot exceed 2 NTUs, and the daily maximum cannot exceed 5 NTUs for the effluent discharged. When dilution ratios are 20:1 or greater, and natural creek turbidity is between 0 and 5 NTUs, then the current Basin Plan objective that "*increases shall not exceed 1 NTU*" would continue to apply.

Environmental analyses often assess the impacts of a change in a plan by comparing the physical circumstances that would result from the plan amendments to the physical circumstances existing at the time the environmental documentation is prepared. This chapter provides this analysis by comparing the results of compliance with the proposed site-specific Basin Plan amendments to the physical circumstances currently existing in and around Deer Creek. The pH and turbidity conditions in Deer Creek under

compliance with the proposed site-specific Basin Plan amendments would be the same as conditions that currently exist in the creek.
Because the proposed project is an amendment to an existing plan, this chapter also addresses the physical circumstances that would result from compliance with the amended Basin Plan to those circumstances that would result from compliance with the existing Basin Plan. Anticipated pH and turbidity conditions in Deer Creek under compliance with current Basin Plan objectives versus compliance with the proposed amendments could occasionally differ. However, potential differences would not be of sufficient magnitude to adversely affect any environmental resources or beneficial uses of Deer Creek water.

In sum, because the site-specific Basin Plan amendments cannot, by definition, cause any significant impacts to the beneficial uses of Deer Creek, the only environmental impacts that might occur would be to environmental resources that are unrelated to the beneficial uses of Deer Creek. As shown in this section, the project would have no significant impacts to those other environmental resources, while the no project alternative is likely to have significant adverse impacts to certain environmental resources.

9.3 ENVIRONMENTAL CHECKLIST

1. **Project Title:**
   Site-specific Basin Plan amendment to the Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins for pH and turbidity at Deer Creek, El Dorado and Sacramento Counties.

2. **Lead Agency Name and Address:**
   California Regional Water Quality Control Board, 3443 Routier Road, Suite A, Sacramento, CA 95827-3003

3. **Contact Person and Phone Number:**
   Rik Rasmussen, Environmental Scientist (916) 255-3103.

4. **Project Location:**
   Deer Creek, California, from its headwaters just north of Cameron Park Lake, located in the west-central portion of El Dorado County, to its confluence with the Cosumnes River, located near State Highway 99 in Sacramento County.

5. **Project Sponsor's Name and Address:**
   California Regional Water Quality Control Board, 3443 Routier Road, Suite A, Sacramento, CA 95827-3003

6. **General Plan Designation:**
   Not applicable

7. **Zoning:**

Not applicable

8. **Description of Project:**

The California Regional Water Quality Control Board, Central Valley Region (Regional Board) is proposing site-specific amendments to the pH and turbidity objectives for Deer Creek in the Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins. The purposes of the proposed amendments are to: (1) address regulatory issues associated with pH and turbidity in Deer Creek, a seasonally effluent-dominated water body; and (2) update the scientific basis for pH and turbidity objectives applicable to Deer Creek. Addressing key regulatory issues associated with effluent dominated/dependant water bodies is a high priority of the Regional Board's Basin Planning Unit, as identified through the 1999 triennial review.

9. **Surrounding Land Uses and Setting:**

The area affected by these site-specific amendments is Deer Creek, source to the Cosumnes River. Deer Creek is a small creek draining the lower woodlands of the western Sierra Nevada foothills in El Dorado and Sacramento Counties. Deer Creek represents the primary water course of its watershed, covering approximately 17 square miles. The land uses along Deer Creek include natural woodlands, wetland habitat, residential, urban, and agriculture. The District's Deer Creek Wastewater Treatment Plant (DCWWTP) is the only municipal wastewater treatment plant discharging to Deer Creek. Beneficial uses of Deer Creek are identified in Section 3 of this Staff Report. Deer Creek is tributary to the Cosumnes River, near the Highway 99 crossing of the Cosumnes River, in Sacramento County. (See Section 1.1.3 of this Staff Report for additional description of the setting, and Figure 1 of this section for a vicinity map.)

10. **Other public agencies whose approval is required:**

State Water Resources Control Board
Office of Administrative Law
United States Environmental Protection Agency

ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED:

The environmental resource categories identified below are analyzed herein to determine whether the Proposed Project would result in adverse impacts to any of these resources. None of the categories below are checked because the Proposed Project is not expected to result in "significant or potentially significant impacts" to any of these resources.

☐ Aesthetics	☐ Biological Resources
☐ Hazards & Hazardous Materials	☐ Mineral Resources
☐ Public Services	☐ Utilities/Service Systems
☐ Agriculture Resources	☐ Cultural Resources
☐ Hydrology/Water Quality	☐ Noise
☐ Recreation	☐ Mandatory Findings of Significance

☐ Air Quality
☐ Land Use Planning
☐ Geology/Soils
☐ Transportation/Traffic

On the basis of this initial evaluation:

☒ I find that the Proposed Project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.[1]

❑ I find that although the Proposed Project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the Project have been made by or agreed to by the Project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.

❑ I find that the Proposed Project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

❑ I find that the Proposed Project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect: 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.

❑ I find that although the Proposed Project could have a significant effect on the environment because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the Proposed Project, nothing further is required.

________________________ ________________________
Signature Date

________________________ ________________________
Printed name For

EVALUATION OF ENVIRONMENTAL IMPACTS

1) A brief explanation is required for all answers except "No Impact" answers that are adequately supported by the information sources a lead agency cites in the parentheses following each question. A "No Impact" answer is adequately supported if the referenced information sources show that the impact simply does not apply to Project's like the one involved (e.g., the Project falls outside a fault

[1] As noted in Section 9.1 above, this chapter includes the report required by 23 Cal. Code Regs. § 3777 in lieu of an environmental impact report or negative declaration.

rupture zone). A "No Impact" answer should be explained where it is based on Project-specific factors as well as general standards (e.g., the Project will not expose sensitive receptors to pollutants, based on a Project-specific screening analysis).

2) All answers must take account of the whole action involved, including off-site as well as on-site, cumulative as well as Project-level, indirect as well as direct, and construction as well as operational impacts.

3) Once the lead agency has determined that a particular physical impact may occur, then the checklist answers must indicate whether the impact is potentially significant, less than significant with mitigation, or less than significant. "Potentially significant Impact" is appropriate if there is substantial evidence that an effect may be significant. If there are one or more "Potentially Significant Impact" entries when the determination is made, an EIR is required.

4) "Negative Declaration: Less Than Significant With Mitigation Incorporated" applies where the incorporation of mitigation measures has reduced an effect from "Potentially Significant Impact" to a "Less than Significant Impact." The lead agency must describe the mitigation measures, and briefly explain how they reduce the effect to a less than significant level (mitigation measures from Section XVII, "Earlier Analysis," may be cross-referenced).

5) Earlier analyses may be used where, pursuant to the tiering, program EIR, or other CEQA process, an effect has been adequately analyzed in an earlier EIR or negative declaration. Section 15063 (c)(3)(D). In this case, a brief discussion should identify the following:

   a) Earlier Analysis Used. Identify and state where they are available for review.

   b) Impacts Adequately Addressed. Identify which effects from the above checklist were within the scope of and adequately analyzed in an earlier document pursuant to applicable legal standards, and state whether such effects were addressed by mitigation measures based on the earlier analysis.

   c) Mitigation Measures. For effects that are "Less than Significant with Mitigation Measures Incorporated," describe the mitigation measures which were incorporated or refined from the earlier document and the extent to which they address site-specific conditions for the Project.

6) Lead agencies are encouraged to incorporate into the checklist references to information sources for potential impacts (e.g., general plans, zoning ordinances). Reference to a previously prepared or outside document should, where appropriate, include a reference to the page or pages where the statement is substantiated.

7) Supporting Information Sources: A source list should be attached, and other sources used or individuals contacted should be cited in the discussion.

8) This is only a suggested form, and lead agencies are free to use different formats; however, lead agencies should normally address the questions from this checklist that are relevant to a Project's environmental effects in whatever format is selected.

9) The explanation of each issue should identify:
   a) The significance criteria or threshold, if any, used to evaluate each question; and
   b) The mitigation measure identified, if any, to reduce the impact to less than significance.

The Environmental Checklist has been prepared in compliance with the requirements of CEQA relating to certified regulatory programs. A statement of facts, supportive discussions, and/or confirming data support each finding of the checklist (see Evaluation of Potential Environmental Impacts). Where appropriate, the supporting discussions are referenced to relevant evaluations and assessments provided in Volume II of this Staff Report:

IMPACT	POTENTIALLY SIGNIFICANT IMPACT	POTENTIALLY SIGNIFICANT UNLESS MITIGATION INCORPORATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
I. AESTHETICS Would the Project:				
a) Have a substantial adverse effect on a scenic vista?	☐	☐	☒	☐
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☐	☐		☒
c) Substantially degrade the existing visual character or quality of the site and its surroundings?	☐	☐	☒	☐
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?	☐	☐	☐	☒
II. AGRICULTURE RESOURCES: In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. Would the Project:				
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☐	☐	☐	☒
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?	☐	☐	☐	☒

IMPACT	POTENTIALLY SIGNIFICANT IMPACT	POTENTIALLY SIGNIFICANT UNLESS MITIGATION INCORPORATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
c) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use?	☐	☐	☐	☒
III. AIR QUALITY – Where available, the significance criteria established by the applicable air quality management or air pollution control the District may be relied upon to make the following determinations. Would the Project:				
a) Conflict with or obstruct implementation of the applicable air quality plan?	☐	☐	☐	☒
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?	☐	☐	☐	☒
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the Project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?	☐	☐	☐	☒
d) Expose sensitive receptors to substantial pollutant concentrations?	☐	☐	☐	☒
e) Create objectionable odors affecting a substantial number of people?	☐	☐	☐	☒
IV. BIOLOGICAL RESOURCES – Would the Project:				
a) Have a substantial adverse effect, either directly, or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulators, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☐	☐	☒
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or US fish and Wildlife Service?	☐	☐	☐	☒
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☐	☐	☐	☒
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of	☐	☐	☐	☒

Impact	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporation	Less Than Significant Impact	No Impact
native wildlife nursery sites?				
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	☒
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	☒
V. CULTURAL RESOURCES – Would the Project:				
a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?	☐	☐	☐	☒
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?	☐	☐	☐	☒
c) Directly or indirectly destroy a unique paleontological resource of site or unique geological feature?	☐	☐	☐	☒
d) Disturb any human remains, including those interred outside of formal cemeteries?	☐	☐	☐	☒
VI. GEOLOGY AND SOILS – Would the Project:				
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:	☐	☐	☐	☒
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	☐	☐	☐	☒
ii) Strong seismic ground shaking?	☐	☐	☐	☒
Iii) Seismic-related ground failure,, including liquefaction?	☐	☐	☐	☒
iv) Landslides?	☐	☐	☐	☒
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☐	☒
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the Project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?	☐	☐	☐	☒
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform building Code (1994), creating substantial risks to life or property?	☐	☐	☐	☒

IMPACT	POTENTIALLY SIGNIFICANT IMPACT	POTENTIALLY SIGNIFICANT UNLESS MITIGATION INCORPORATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
VII. HAZARDS AND HAZARDOUS MATERIALS – Would the Project:				
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☐	☒
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment/	☐	☐	☐	☒
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☐	☐	☐	☒
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☐	☒
e) For a Project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the Project result in a safety hazard for people residing or working in the Project area?	☐	☐	☐	☒
f) For a Project within the vicinity of a private airstrip, would the Project result in a safety hazard for people residing or working in the Project area?	☐	☐	☐	☒
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	☒
h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?	☐	☐	☐	☒
VIII. HYDROLOGY AND WATER QUALITY – Would the Project:				
a) Violate any water quality standards or waste discharge requirements?	☐	☐	☐	☒
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of preexisting nearby wells would drop to a	☐	☐	☐	☒

IMPACT	POTENTIALLY SIGNIFICANT IMPACT	POTENTIALLY SIGNIFICANT UNLESS MITIGATION INCORPORATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
level which would not support existing land uses or planned uses for which permits have been granted?				
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?	☐	☐	☐	☒
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which results in flooding on- or off-site?	☐	☐	☐	☒
e) Create or contribute runoff water which exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?	☐	☐	☐	☒
f) Otherwise substantially degrade water quality?	☐	☐	☒	☐
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?	☐	☐	☐	☒
h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows?	☐	☐	☐	☒
i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?	☐	☐	☐	☒
j) Inundation by seiche, tsunami, or mudflow?	☐	☐	☐	☒
IX. LAND USE AND PLANNING – Would the Project:				
a) Physically divide an established community?	☐	☐	☐	☒
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the Project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☐	☒
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?	☐	☐	☐	☒

Impact	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporation	Less Than Significant Impact	No Impact
X. MINERAL RESOURCES – Would the Project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☐	☒
b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?	☐	☐	☐	☒
XI. NOISE – Would the Project result in:				
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☐	☐	☐	☒
b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?	☐	☐	☐	☒
c) A substantial permanent increase in ambient noise levels in the Project vicinity above levels existing without the Project?	☐	☐	☐	☒
d) A substantial temporary or periodic increase in ambient noise levels in the Project vicinity above levels existing without the Project?	☐	☐	☐	☒
e) For a Project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the Project expose people residing or working in the Project area to excessive noise levels?	☐	☐	☐	☒
f) For a Project within the vicinity of a private airstrip, would the Project expose people residing or working in the Project area to excessive noise levels?	☐	☐	☐	☒
XII. POPULATION AND HOUSING – Would the Project?				
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☐	☒
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒
XIII. PUBLIC SERVICES				

IMPACT	POTENTIALLY SIGNIFICANT IMPACT	POTENTIALLY SIGNIFICANT UNLESS MITIGATION INCORPORATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
a) Would the Project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:				
Fire protection?	☐	☐	☐	☒
Police protection?	☐	☐	☐	☒
Schools?	☐	☐	☐	☒
Parks?	☐	☐	☐	☒
Other public facilities?	☐	☐	☐	☒
XIV. RECREATION				
a) Would the Project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☐	☒
b) Does the Project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?	☐	☐	☐	☒
XV. TRANSPORTATION/TRAFFIC – Would the Project:				
a) Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio to roads, or congestion at intersections?	☐	☐	☐	☒
b) Exceed, either individually or cumulatively, a level of service standard established by the county congestion/management agency for designated roads or highways?	☐	☐	☐	☒
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?	☐	☐	☐	☒
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☐	☒
e) Result in inadequate emergency access?	☐	☐	☐	☒
f) Result in inadequate parking capacity?	☐	☐	☐	☒

Impact	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporation	Less Than Significant Impact	No Impact
g) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?	☐	☐	☐	☒
XVI. UTILITIES AND SERVICE SYSTEMS – Would the Project?				
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	☐	☐	☐	☒
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	☒
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	☒
d) Have sufficient water supplies available to serve the Project from existing entitlements and resources, or are new or expanded entitlements needed?	☐	☐	☐	☒
e) Result in a determination by the wastewater treatment provider which serves or may serve the Project that it has adequate capacity to serve the Project's projected demand in addition to the provider's existing commitments?	☐	☐	☐	☒
f) Be served by a landfill with sufficient permitted capacity to accommodate the Project's solid waste disposal needs?	☐	☐	☐	☒
g) Comply with federal, state, and local statutes and regulations related to solid waste?	☐	☐	☐	☒
XVII. MANDATORY FINDINGS OF SIGNIFICANCE				
a) Does the Project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number of restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	☐	☐	☐	☒
b) Does the Project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in	☐	☐	☐	☒

Impact	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporation	Less Than Significant Impact	No Impact
connection with the effects of past projects, the effects of other current projects, and the effects of probably future projects)?				
c) Does the Project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	☐	☐	☐	☒

9.4 THRESHOLDS OF SIGNIFICANCE

For the purposes of making impact determinations, potential impacts were determined to be significant if the Proposed Project or its alternatives would result in one or both of the following:

- pH and/or turbidity conditions in Deer Creek that would adversely affect Deer Creek's beneficial uses; or
- changes in environmental condition that would, either directly or indirectly, cause a substantial loss of habitat or substantial degradation of water quality or other resources.

9.5 ENVIRONMENTAL IMPACTS OF THE PROPOSED PROJECT

Each resource category of the Environmental Checklist is supported by the following discussions and source information, as cited.

9.5.1 Aesthetics

The Proposed Project would establish site-specific water quality objectives for Deer Creek pH and turbidity through approval of the proposed site-specific Basin Plan amendments.

Approval and implementation of the proposed site-specific pH and turbidity objectives would not result in measurable changes in pH conditions in Deer Creek or downstream water bodies, relative to existing conditions. The Proposed Project would not necessitate any change in facilities or operations of the DCWWTP; therefore, downstream flows and water quality would remain unchanged, relative to existing conditions, all upstream factors remaining constant. The existing pH and turbidity conditions in Deer Creek are protective of the Creek's beneficial uses. Levels of these parameters are not adversely affecting any resources currently.

Anticipated pH and turbidity conditions in Deer Creek under the proposed site-specific objectives would differ only slightly, and occasionally, from pH and turbidity conditions under compliance with the current Basin Plan objectives for these parameters. These slight differences in pH levels would have no perceptible effect on Deer Creek's aquatic ecology, flows, riparian habitats, or any other aesthetic qualities of the creek. Potential differences in average turbidity levels between current and proposed objectives would be minor, and would only occur when natural creek turbidities were below 2 NTUs. Minor changes in creek turbidity levels, when creek turbidity remains at or below 2 NTUs, are generally not apparent to the human eye. Moreover, the slight increases in average turbidities that could occur during summer and fall months when natural creek turbidities are below 2 NTUs would not adversely affect the creek's aquatic ecology, flows, riparian habitats, or any other aesthetic qualities of the creek. Although the proposed objective would allow daily high turbidity levels to exceed the 2 NTU average, downstream of the DCWWTP, daily high turbidity levels in the creek would rarely exceed 2 NTUs when the proposed objective was applicable. Normal plant operations, when natural creek turbidity is between 0 and 5 NTUs, would typically result in effluent turbidity between about 0.20 and 2 NTUs, with a daily average turbidity nearly always less than 1.5 NTUs, and typically less than 1 NTU (see District self monitoring reports period 1998-2001).

Overall, the proposed site-specific Basin Plan amendments would have a **less-than-significant** impact to Deer Creek aesthetics.

Because aesthetic impacts of the proposed amendments would be less-than-significant to Deer Creek itself, impacts to aesthetics of the Cosumnes River (to which Deer Creek is tributary) and other downstream water bodies also would be less-than-significant.

9.5.2 Agricultural Resources

The Proposed Project would establish site-specific water quality objectives for Deer Creek pH and turbidity through approval of the proposed site-specific Basin Plan amendments.

Approval and implementation of the proposed site-specific pH and turbidity objectives would not result in measurable changes in pH or turbidity conditions in Deer Creek or downstream water bodies, relative to existing conditions. Existing pH and turbidity conditions in Deer Creek are not adversely affecting agricultural resources.

Anticipated pH and turbidity conditions in Deer Creek under the proposed site-specific objectives would differ only slightly and occasionally from pH and turbidity conditions under compliance with the current Basin Plan objectives for these parameters. By definition, Deer Creek pH and turbidity conditions anticipated to occur under the proposed objectives would be protective of agricultural uses of Deer Creek water. Consequently, no agricultural resources, including farmland irrigation and livestock watering, would be affected by the Proposed Project.

Overall, the proposed site-specific Basin Plan amendments would have **no impact** on agricultural resources of Deer Creek or downstream water bodies.

9.5.3 Air Quality

The Proposed Project would establish site-specific water quality objectives for Deer Creek pH and turbidity through approval of the proposed site-specific Basin Plan amendments. Because pH and turbidity do not affect air quality directly, there would be no direct impacts from the Proposed Project on air quality. Because implementation of the Proposed Project would not involve any construction-related activities that would generate increased concentrations of pollutants, objectionable odors, or obstruct the implementation of any air quality plan, there would be no secondary impacts from the Proposed Project on air quality. The proposed site-specific Basin Plan amendments would therefore, have **no impact** on air quality.

9.5.4 Biological Resources

9.5.4.1 pH

The proposed site-specific pH objective would maintain creek pH between 6.5 and 8.5 pH units, which is the same range required under the current Basin Plan Objective. This range of creek pH conditions has no potential to adversely affect riparian vegetation, terrestrial organisms, or any other non-aquatic biological resource. As for aquatic life uses, because the Proposed Project would not change the range of pH applicable to Deer Creek, relative to the current Basin Plan Objective, it could not cause any impacts related to seasonal pH range. Nevertheless, information provided in Appendix D shows that Deer Creek pH would be maintained within the 6.5 to 8.5 range. Moreover, Appendix C provides information to demonstrate that this range is protective of freshwater aquatic life. Occasions when downstream pH would be higher than 8.5 would be caused by high receiving water pH, not from the direct influence of effluent discharge from the DCWWTP on creek pH.

The amendment only eliminates the “0.5-unit change” requirement of the current Basin Plan Objective. Therefore, the remainder of this assessment will focus on the potential of pH changes to aquatic life when resultant pH remains between 6.5 and 8.5.

The scientific literature reviewed indicates that even rapid pH changes within the 6.5 to 8.5 range are clearly not lethal, and have no long-term adverse effects on fish and benthic macroinvertebrates. In Deer Creek, there would be no sudden reduction in pH at any site. Subsequently, although numerous studies have shown that rapid lowering of pH will trigger increased drift in benthic macroinvertebrate communities (e.g., Kratz et al. 1994), these organisms would only be exposed to rapid pH changes if they were already drifting through the mixing zone associated with the DCWWTP discharge. Hence, rates of drift from upstream to downstream would be unaffected by effluent discharges.

Due to a large cascade located immediately below the lower end of the mixing zone, fish and macroinvertebrates cannot enter the mixing zone from downstream. As stated above, aquatic organisms immediately downstream of the cascade would not be subjected to rapid changes in pH, but rather would simply exist in an environment having a somewhat lower pH than that which exists upstream, but still within the 6.5 to 8.5 range. The primary movement through the mixing zone that occurs is in an upstream to downstream direction via natural macroinvertebrate drift. Fish movement in this manner is believed to be negligible.

Downstream macroinvertebrate movements would primarily consist of those organisms associated with the creek's macroinvertebrate "drift" phenomenon. Neither the fish nor the macroinvertebrate communities of Deer Creek, upstream of the DCWWTP, include species that have true downstream migrations that would result in the entire population having to pass through the mixing zone, annually. Rather, a very small percentage of the population of any upstream organism would pass through the mixing zone during a given month or year. Organisms passing through the effluent mixing zone (moving downstream from upstream locations) may be rapidly exposed to pH changes over short periods of time. The rapid pH changes to which such organisms would be exposed would not be expected to result in acute mortality or chronic sublethal effects because all pH levels to which they would be exposed would be between 6.5 to 8.5 (Appendix C).

Organisms residing within the mixing zone itself would be exposed to pH levels intermediate between those occurring upstream and downstream. Moreover, the rapid pH changes experienced by organisms within the mixing zone would be substantially smaller in magnitude compared to those experienced by an organism moving from an upstream location, through the mixing zone, to a downstream location. Hence, the concern over pH shock for organisms residing within the mixing zone is small, as long as the pH within the zone remains between 6.5 and 8.5 units. See Appendix C for a further discussion on pH shock.

In addition to the considerations discussed above, imposing the current pH objective at Deer Creek could, at times, both directly and indirectly increase the risk of harm to fish and macroinvertebrate communities residing downstream of the point of effluent discharge. Historic pH data show that Deer Creek has a naturally occurring pH upstream of effluent discharge from the DCWWTP that occasionally exceeds 8.5 units. Levels as high as 8.9 units have been reported (Appendix D). Under such conditions, reduction of Deer Creek pH by more than 0.5 units, as a result of effluent discharges, would be more beneficial than harmful to downstream aquatic life. Such pH reductions would provide direct benefits to some of the creek's aquatic life by reducing the pH to a more physiologically acceptable level (i.e., the influence of the effluent would bring downstream pH back into the 6.5 to 8.5 range required by the Basin Plan, both currently and under this amendment), and would provide indirect benefits to all fish and macroinvertebrates residing downstream by reducing the risk that downstream un-ionized ammonia concentrations would reach toxic levels. Thus, when Deer Creek pH upstream of the DCWWTP exceeds about 8.0, and particularly when it exceeds 8.5, a decrease in downstream pH of more than 0.5 units as a result of effluent discharge would actually be more beneficial than harmful to the creek's downstream biota.

Finally, it should be noted that photosynthesis and other natural biochemical processes cause the pH of Deer Creek downstream of R2 to increase. For example, field data collected on July 21, 1997 showed that the pH at R2 was 7.7 at 4:30 pm, whereas pH measured one mile downstream just one hour earlier (i.e., at 3:30 pm) was 8.8. The addition of lime or other chemicals to increase effluent pH to levels similar to those occurring upstream during the summer (i.e., 8.0-8.5) would increase the probability that downstream pH levels would be above the 8.5 limit specified in the Basin Plan, and that high pH levels would adversely affect aquatic life at downstream sites.

Weekly monitoring of Deer Creek pH from the District's R1 water quality monitoring station (located approximately 0.25 miles (400 m) upstream of the point of effluent mixing under low-flow conditions and about 100 m upstream under high-flow conditions) to the Cosumnes River at Hwy 99 was conducted by SWRI between February 3, 1998 and March 3, 1998. Of the dates monitored, the flow rate in Deer Creek was highest on February 3 (when the creek was at flood stage) and declined for all subsequent monitoring events through March 3. Dilution ratios for receiving water to effluent volumes were estimated to be well in excess of 100:1 on February 3, and were estimated to be approximately 8:1, 7:1, and 5:1 on February 16, February 26, and March 3, respectively. During all four sampling events, Deer Creek had visible discharge into the Cosumnes River. However, on March 3, 1998, when Deer Creek and effluent discharges were measured at approximately 28 cfs (18.1 mgd) and 4.9 cfs (3.2 mgd), respectively, the discharge of Deer Creek into the Cosumnes River was small.

Deer Creek's influence on Cosumnes River pH is less than measurable, regardless of Deer Creek discharge (**Figure 5**). The data collected between February 3, 1998 and March 3, 1998 indicate that pH in the lower reaches of Deer Creek under high-flow conditions is primarily influenced by surrounding geology, tributary input, and runoff, with no detectable influence of effluent discharges from the DCWWTP. During the summer/fall low-flow period of the year, Deer Creek's influence on Cosumnes River pH also would be negligible. Consequently, effluent discharges from the DCWWTP have no measurable impact on Cosumnes River pH. These findings indicate that approval and implementation of the proposed site-specific pH objective for Deer Creek would have no measurable effects on Cosumnes River pH and, therefore, aquatic life during any month of the year.

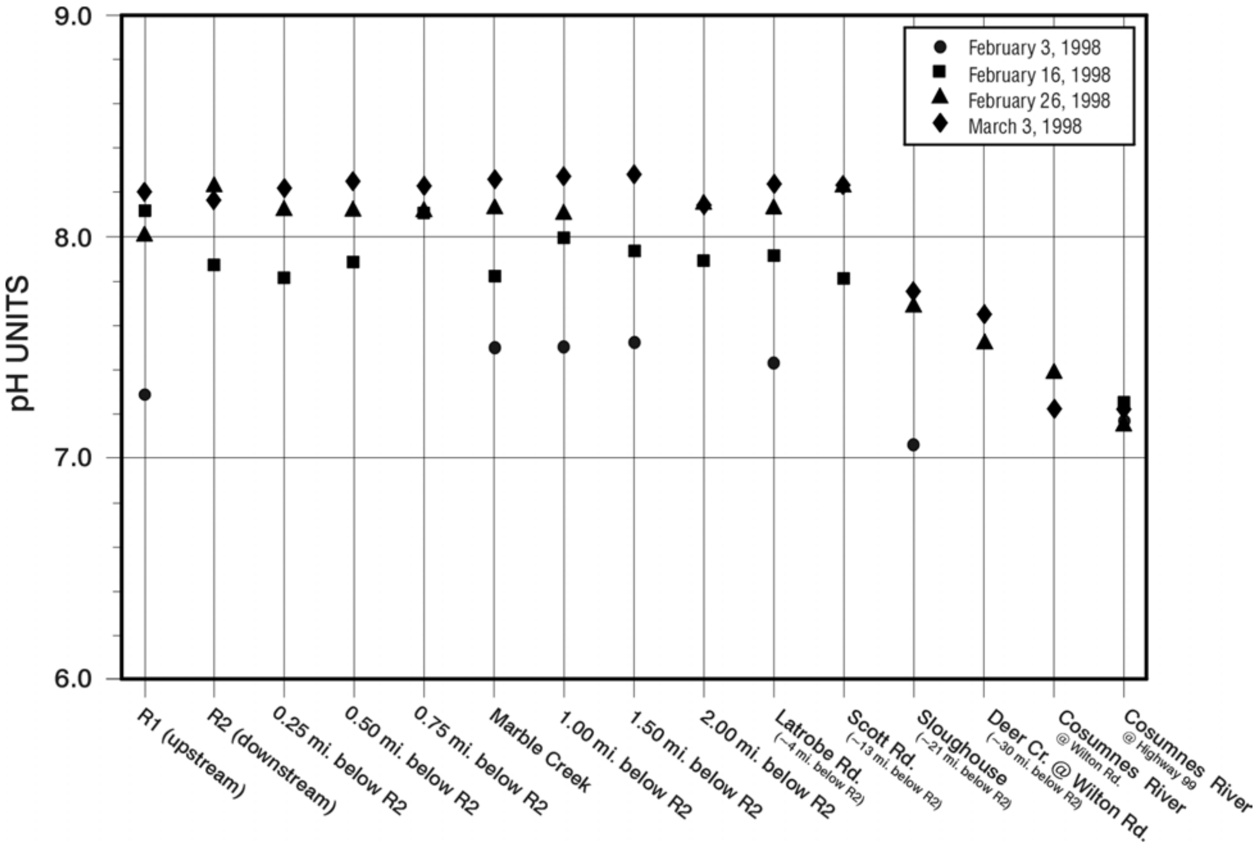

Figure 5. pH levels measured at various locations in Deer Creek, in Marble Creek just above its confluence with Deer Creek, and at two locations in the Cosumnes River during the period February 3, 1998 through March 3, 1998.

In summary, approval and implementation of the proposed site-specific pH objective would not result in measurable changes in pH conditions in Deer Creek or downstream water bodies, relative to existing conditions. Existing creek pH conditions are not adversely affecting the creek's aquatic communities. Anticipated pH conditions in Deer Creek under the proposed site-specific objectives would differ only slightly and occasionally from pH conditions under compliance with the current Basin Plan objectives for this parameter. The slight and occasional difference that could occur in creek pH between the proposed and current pH objectives would have no effects on aquatic biota within Deer Creek or downstream water bodies.

Overall, the proposed site-specific pH objective would have a **less-than-significant impact** to biological resources.

9.5.4.2 Turbidity

Approval and implementation of the proposed site-specific turbidity objective would not result in substantial changes in turbidity levels in Deer Creek or downstream water bodies, relative to existing conditions. Moreover, existing creek turbidity conditions are not adversely affecting the creek's aquatic communities.

In addition, anticipated turbidity conditions in Deer Creek under the proposed site-specific objectives would differ only slightly and occasionally from turbidity conditions under compliance with the current Basin Plan objectives for turbidity. The slight, and occasional difference, that could occur in creek turbidity between the proposed and current turbidity objectives would have no effects on aquatic biota within Deer Creek or downstream water bodies, nor any other biological resources associated with Deer Creek.

Under the proposed site-specific turbidity objective for Deer Creek, the current Basin Plan turbidity objective, applicable when natural creek turbidity is between 0 and 5 NTUs, would be modified for periods when the dilution ratio Deer Creek water to effluent discharge is less than 20:1. Under these conditions, the turbidity of the discharge would be restricted to 2 NTUs (daily average) and 5 NTUs (daily maximum). When the dilution ratio of receiving water to discharge flow is greater than 20:1, and natural turbidity is between 0 and 5 NTUs, the increase in turbidity shall not exceed 1 NTU. Under the latter condition described, the proposed objective and the current Basin Plan objective are the same. At all other times of the year, when natural creek turbidity exceeds 5 NTUs, the other existing Basin Plan turbidity objectives would remain in effect.

Relationships between effluent TSS concentrations and turbidity levels suggest that daily average/maximum turbidities of 2/5 NTUs would equate, on the average, with daily average/maximum TSS concentrations of approximately 3/10 mg/l. Based on the technical discussion presented in Appendix E, TSS (and associated turbidity levels) in this range would be protective of Deer Creek's fish and macroinvertebrate communities. Average monthly turbidities maintained at or below 2 NTUs throughout the primary vegetation growing season (i.e., May through October) would not be expected to adversely affect the creek's plant community ecology.

The component of the proposed objective that states where natural turbidity is between 0 and 5 NTUs, and the dilution ratio is 20:1 or greater, increases in creek turbidity shall not exceed 1 NTU. also can be consistently achieved in Deer Creek. In fact, when 20:1 or greater dilution occurs in the creek, effluent discharges from the DCWWTP would not be expected to increase downstream turbidity but rather would be expected to decrease downstream turbidity. Based on the turbidity requirements of aquatic life reviewed in Appendix E, this component of the proposed objective also would be protective of the aquatic biota of Deer Creek.

Because the proposed amendment was developed with clear consideration of near zero receiving water flows and undiluted effluent quality, the proposed amendment is capable of being consistently met regardless of the future rates of effluent discharge. In fact, available data suggest that the proposed turbidity objective can be complied with (downstream of the DCWWTP) regardless of the rate of effluent discharge, assuming typical quality of effluent discharges from the DCWWTP.

Weekly monitoring of Deer Creek turbidity from the District's R1 water quality monitoring station (located approximately 0.25 miles (400 m) upstream of the point of effluent mixing under low-flow conditions and about 100 m upstream under high-flow conditions) to the Cosumnes River at Hwy 99 was conducted by SWRI between February 3, 1998 and March 3, 1998. Of the dates monitored, the flow rate in Deer Creek was highest on February 3 (when the creek was at flood stage) and declined for all subsequent monitoring events through March 3. Dilution ratios for receiving water to effluent volumes were estimated to be well in excess of 100:1 on February 3, and were estimated to be approximately 8:1, 7:1, and 5:1 on February 16, February 26, and March 3, respectively. During all four sampling events, Deer Creek had visible discharge into the Cosumnes River. However, on March 3, 1998, when Deer Creek and effluent discharges were measured at approximately 28 cfs (18.1 mgd) and 4.9 cfs (3.2 mgd), respectively, the discharge of Deer Creek into the Cosumnes River was small.

The turbidity data collected during the February 3, 1998 through March 3, 1998 period (when Deer Creek has continuous surface flow to the Cosumnes River) demonstrate three important points. First, on all four dates monitored, turbidities in Deer Creek at the R2 (downstream) location were substantially lower than Deer Creek turbidities further downstream. This is likely due to greater amounts of exposed soil contributing to highly turbid runoff from the watershed associated with the lower reaches of Deer Creek, relative to lands adjacent to and upstream of the DCWWTP. Second, turbidity at the R2 location was always substantially lower than that of the Cosumnes River. Third, with the exception of February 16, 1998, the influence of effluent turbidity on the turbidity of Deer Creek immediately downstream from the point of discharge was minimal. On February 16, 1998, turbidity measured at the R2 location was approximately one-third that measured at the R1 (immediate upstream) location, indicating that creek turbidity was significantly reduced upon dilution with lower turbidity effluent (**Figure 6**). This phenomenon is believed to occur commonly during the precipitation period of the year when creek turbidities are often at or near seasonal highs.

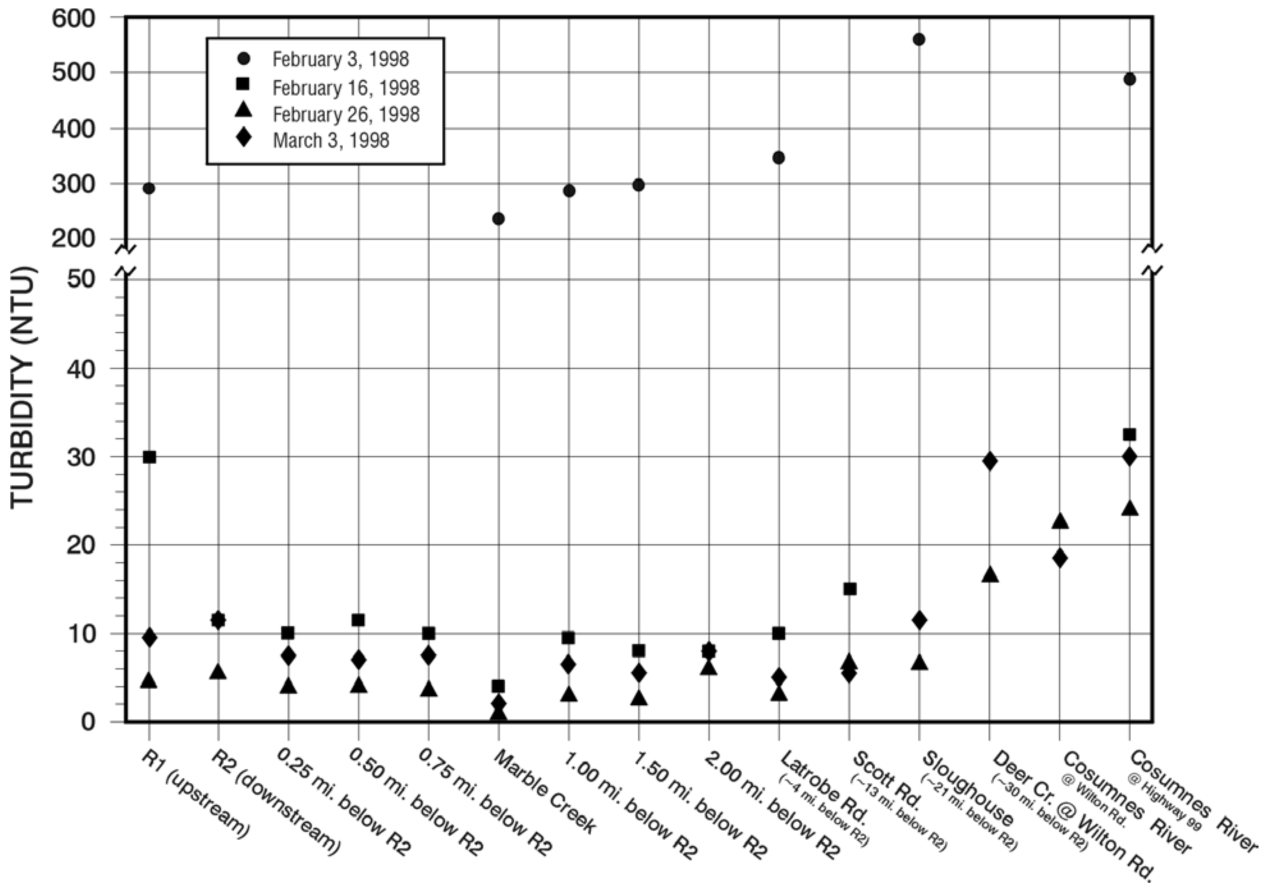

Figure 6. Turbidity levels measured at various locations in Deer Creek, in Marble Creek just above its confluence with Deer Creek, and at two locations in the Cosumnes River during the period February 3, 1998 through March 3, 1998.

The data discussed above, and shown in Figure 6, indicate that, from a turbidity perspective, Deer Creek's influence on Cosumnes River is negligible, and not biologically significant. The data collected between February 3, 1998 and March 3, 1998 indicate that turbidity in the lower reaches of Deer Creek under high-flow conditions is primarily influenced by surrounding land use, tributary input, and runoff, and has little relation to creek turbidity immediately above or below the DCWWTP. Consequently, effluent discharges from the DCWWTP have no measurable impact on Cosumnes River turbidity.

When Deer Creek lacks surface flow continuity, and flows become subterranean in various reaches, Deer Creek's influence on Cosumnes River turbidity would be negligible or would be turbidity reducing in nature. This is because creek water would flow through the sand and gravel of the creek bed in various reaches, and then through wetland habitats near Sloughhouse prior to reaching the Cosumnes River.

This routing of water would provide extensive natural filtration. The net result is water of low turbidity entering the Cosumnes River that has undergone natural filtration and settling for many miles between the DCWWTP and the confluence with the Cosumnes River. In any event, Deer Creek water entering the Cosumnes River would never cause a change in turbidity of sufficient magnitude to affect (positively or negatively) the aquatic life of the Cosumnes River.

These findings indicate that implementation of the proposed site-specific turbidity objective for Deer Creek would have no measurable effects on Cosumnes River turbidity and, therefore, aquatic life during any month of the year.

In summary, based on the available technical information, the proposed site-specific turbidity objective, that would be applicable when natural Deer Creek turbidity is between 0 and 5 NTUs, would be protective of the creek's aquatic life and, therefore, would have a **less-than-significant impact** to biological resources.

9.5.5 Cultural Resources

The Proposed Project would establish site-specific water quality objectives for Deer Creek pH and turbidity through approval of the proposed site-specific Basin Plan amendments. The Proposed Project would not involve any action or activity that would cause an adverse change in historical, archaeological, paleontological resources, or human remains (such as exposure, destruction, etc…). The proposed site-specific Basin Plan amendments would have **no impact** on cultural resources.

9.5.6 Geology and Soils

The Proposed Project would establish site-specific water quality objectives for Deer Creek pH and turbidity through approval of the proposed site-specific Basin Plan amendments. The Proposed Project would not involve any action or physical activity (e.g., construction) that would expose people or structures to the risk of loss, injury, or death involving: a known earthquake fault, strong seismic ground shaking, seismic related ground failure, or landslides. Also, the Proposed Project would not involve any action or result in any changing of hydrological regimes that would expose people or structures to increased soil erosion, unstable soil, or expansive soil. The proposed site-specific Basin Plan amendments would have **no impact** on geology or soils.

9.5.7 Hazards and Hazardous Materials

The Proposed Project would establish site-specific water quality objectives for Deer Creek pH and turbidity through approval of the proposed site-specific Basin Plan amendments. No changes to physical facilities or operations at the DCWWTP or other facilities would be required under the Proposed Project. The Proposed Project would not involve new hazards or any action or physical activity that would introduce or remove hazardous materials. The proposed site-specific Basin Plan amendments would have **no impact** on current or potential hazards or hazardous materials.

9.5.8 Hydrology

The Proposed Project would establish site-specific water quality objectives for Deer Creek pH and turbidity through approval of the proposed site-specific Basin Plan amendments. Approval and implementation of the proposed site-specific pH and turbidity objectives would have no direct effect on Deer Creek hydrology, relative to existing conditions. Existing creek hydrology is not adversely affecting the creek's aquatic communities, or other beneficial uses. In addition, anticipated creek hydrology under the proposed site-specific objectives would be identical to creek hydrology under compliance with the current Basin Plan objectives for pH and turbidity.

Additionally, the Proposed Project would not effect erosion or siltation rates, existing drainage pattern of the site or area, or the amount of area runoff. The Proposed Project would not change the 100-year flood magnitude or route, expose people or structures to significant risk of loss, injury, or death involving flooding, or increase the potential for inundation by seiche, tsunami, or mudflow.

The proposed site-specific Basin Plan amendments would have **no impact** on hydrology of Deer Creek or downstream water bodies.

9.5.9 Land Use and Planning

The Proposed Project would establish site-specific water quality objectives for Deer Creek pH and turbidity through approval of the proposed site-specific Basin Plan amendments. The Proposed Project would not involve any action, physical activity, or land use change that would divide any established community, conflict with any land use plan, policy or regulation, or conflict with any habitat conservation plan or natural community plan. The proposed site-specific Basin Plan amendments would have **no impact** on land use and planning.

9.5.10 Mineral Resources

The Proposed Project would establish site-specific water quality objectives for Deer Creek pH and turbidity through approval of the proposed site-specific Basin Plan amendments. The Proposed Project would not involve any action or physical activity that would result in the loss of any known mineral resource or known mineral resource site. The proposed site-specific Basin Plan amendments would have **no impact** on mineral resources.

9.5.11 Noise

The Proposed Project would establish site-specific water quality objectives for Deer Creek pH and turbidity through approval of the proposed site-specific Basin Plan amendments. The Project would not involve any action or physical activity (e.g., construction) that would result in increased noise levels or exposure of people to noise. The proposed site-specific Basin Plan amendments would have **no impact** on noise.

9.5.12 Population and Housing

The Proposed Project would establish site-specific water quality objectives for Deer Creek pH and turbidity through approval of the proposed site-specific Basin Plan amendments. The immigration of people to an area is typically influenced by such factors as job opportunities, affordable housing, quality schools and public services, and aesthetic quality, among others. Water quality objectives will not likely encourage or discourage people from moving to the Deer Creek area. Also, since the Project involves no action or physical activity associated with land conversions, no housing would need to be relocated or otherwise affected. Implementation of the proposed site-specific Basin Plan amendments would have **no impact** on population or housing.

9.5.13 Public Services

The Proposed Project would establish site-specific water quality objectives for Deer Creek pH and turbidity through approval of the proposed site-specific Basin Plan amendments. The Proposed Project would not involve any action that would adversely affect fire protection, police protection, schools, parks, or any other public facility. The proposed site-specific Basin Plan amendments would have **no impact** on public services.

9.5.14 Recreation

The Proposed Project would have **no impact** on existing or probable future recreational facilities in that no new structures or alterations of existing facilities or land uses are proposed. The following discussion addresses the Proposed Project's potential to affect recreation in and along Deer Creek and downstream water bodies.

9.5.14.1 pH

Approval and implementation of the proposed site-specific pH objective would not change the actual aesthetics, aquatic ecology, wildlife use, flow rates, or any other observable characteristic of Deer Creek, relative to existing conditions. Existing pH conditions in Deer Creek have no effect on recreation in or along the creek. Secondly, anticipated pH conditions in Deer Creek under the proposed site-specific objectives would differ only slightly and occasionally from pH conditions under compliance with the current Basin Plan objectives for pH. The slight, and occasional, difference that could occur in creek pH between the proposed and current pH objectives would have no effect on creek aesthetics, aquatic ecology, wildlife use, flow rates, or any other observable characteristic of Deer Creek that affect recreation in or along the creek. This is because the proposed site-specific pH objective was developed to be protective of all Deer Creek's beneficial uses, including recreation. The proposed site-specific Basin Plan amendment for pH would have **no effect** on the recreational uses of Deer Creek or downstream water bodies.

9.5.14.2 Turbidity

Approval and implementation of the proposed turbidity objective would not change actual Deer Creek turbidities, relative to existing conditions. Existing turbidity conditions in Deer Creek are not adversely impacting recreation in or along the creek.

When Deer Creek's natural turbidity is between 0 and 5 NTUs, the current Basin Plan objective restricts the change in turbidity (caused by a discharge) to 1 NTU. The Basin Plan also states three other turbidity objectives that are applicable when creek turbidity is between: 1) 5 and 50 NTUs; 2) 50 and 100 NTUs; and 3) greater than 100 NTUs. At all other times of the year when natural creek turbidity exceeds 5 NTUs, these other existing Basin Plan turbidity objectives would remain in effect under the Proposed Project.

Under the proposed site-specific turbidity objective, the current Basin Plan turbidity objective applicable when natural creek turbidity is between 0 and 5 NTUs would be modified for periods when the dilution ratio of receiving water to discharge flow is less than 20:1. Under these conditions, the turbidity of the discharge would be restricted to 2 NTUs (daily average) and 5 NTUs (daily maximum). When the dilution ratio of receiving water to discharge flow is greater than 20:1, and natural turbidity is between 0 and 5 NTUs, the increase in turbidity shall not exceed 1 NTU. Under the latter condition described, the proposed objective and the current Basin Plan objective are the same.

Under low-flow and turbidity conditions in the creek (i.e. creek turbidity of <1 NTU), the proposed objective would allow daily average turbidity to increase to no more than 2 NTUs, with an instantaneous maximum of 5 NTUs. Differences in turbidity levels between 0 and 2 NTUs are generally difficult to visually discern in a creek channel with the naked eye. In other words, water having a turbidity of ≤ 2 NTUs looks, aesthetically, very similar to water of ≤ 1 NTU when flowing through a creek channel. These levels of turbidity are far below levels that could adversely affect observable characteristics of the creek. For comparison purposes U.S. EPA's 1999 National Primary Drinking Water Standards (USEPA 1999) state that final treated drinking water supplies shall not exceed 5 NTUs, and systems that filter must ensure that the turbidity of finished drinking water supplies not exceed 1 NTU.

The instantaneous high turbidity of 5 NTUs allowed under the proposed objective also is consistent with the Department of Health Services (DHS) recommendations for treatment of municipal wastewater when the dilution ratio of receiving water to discharge flow is less than 20:1. As such, Regional Board staff consider it (along with the 2 NTUs daily average limit) to be protective of recreational uses. The 5 NTUs level is still below levels that could adversely affect any life stage of aquatic life (see Appendix E) and is considered protective of aquatic life uses. The effect of the instantaneous high component of the proposed objective on aesthetic enjoyment is believed to be minimal as well because the frequency with which a 5-NTU condition would occur downstream of the DCWWTP discharge (when the dilution ratio of receiving water to discharge flow is less than 20:1 and natural turbidity is between 0 and 5 NTUs) would be extremely low. The 5-NTU component of the proposed objective would have no effect on wildlife use, flow rates, or other observable characteristics of the creek that affect recreation in or along the creek.

Regional water-related recreation destinations and average turbidity levels at those locations are presented in **Table 4**. As shown by this table, recreational activities such as swimming readily occur at locations with average turbidities exceeding the range proposed by the site-specific turbidity objective (between 0 and 5 NTUs). This can further be demonstrated for all other recreational activities engaged along Deer Creek. Therefore, it can be determined that turbidity levels in and above the range that would likely result from implementing the proposed site-specific turbidity objective for Deer Creek would not deter existing recreational uses on Deer Creek.

Under conditions when the creek's natural ambient turbidity is between 1 and 2 NTUs, the proposed objective would result in average turbidity increases (due to discharges) being 1 NTU or less, because of the 2 NTU limit on average turbidity levels of effluent discharges. Moreover, in cases when the creek's natural turbidity is between 2 and 5 NTUs, compliance with the proposed objective could result in a reduction in ambient creek turbidity. Under these latter two scenarios, the Proposed Project's turbidity objective is equal or more restrictive than the current Basin Plan's turbidity objective.

Finally, because the proposed turbidity objective would have less-than-significant impacts on recreation in Deer Creek itself, it also would be expected to have less-than-significant impacts on downstream water bodies, following mixing of tributary waters. Effects of Deer Creek water on Cosumnes River turbidity are typically so small as to not be detectable.

Based on the above findings, the proposed turbidity objective would have **less-than-significant** impacts on recreational opportunities in and along Deer Creek and downstream water bodies.

Table 4. Average turbidity of popular recreational destinations.

Recreational Destination	Average Turbidity (NTU)
Sacramento River at Freeport (1990-1995) /a/	
March	22
June	6.2
September	9.8
December	8.1
American River at Cal. State University (1977-1979) /a/	
March	6.0
June	1.0
September	2.0
December	3.0
January	13.6
Folsom Reservoir /b/ (approximate)	
Summer Inflow	1.0-2.0
Top of Water	<1.0
Shoreline	<10.0
Sly Park Reservoir /c/	
Summer (open water)	1.0
Winter (open water)	3.0-12.0
Clear Lake (1985-1992) /d/	
Summer	8.1
Winter	8.8

/a/ Miyashita, 1998.
/b/ Vonich, 1998.
/c/ Cooper, 1998.
/d/ Richerson, 1998.

9.5.15 Transportation/Traffic

The Proposed Project would establish site-specific water quality objectives for Deer Creek pH and turbidity through approval of the proposed site-specific Basin Plan amendments. The Proposed Project would not involve any action that would affect amounts of traffic or congestion, road management, traffic patterns, traffic hazards, emergency access, parking, or current transportation policies. The proposed site-specific Basin Plan amendments would have **no impact** on transportation or traffic.

9.5.16 Utilities and Service Systems

The Proposed Project would establish site-specific water quality objectives for Deer Creek pH and turbidity through approval of the proposed site-specific Basin Plan amendments. The Proposed Project would not involve any action that would affect the current regulations or utilities or the need for new utilities. The proposed site-specific Basin Plan amendments would have **no impact** on utilities and service systems.

9.5.17 Water Quality

The Proposed Project would establish site-specific water quality objectives for Deer Creek pH and turbidity through approval of the proposed site-specific Basin Plan amendments. The Proposed Project has the potential to *affect* these water quality parameters in Deer Creek, but would have no effect on other water quality parameters. However, the site-specific pH and turbidity objectives proposed were developed to be protective of in-stream beneficial uses of Deer Creek and provide the level of water quality necessary to protect these uses.

Approval and implementation of the proposed site-specific pH objective would not result in changes in pH or turbidity conditions in Deer Creek or downstream water bodies, relative to existing conditions. Moreover, existing creek pH and turbidity conditions are not adversely affecting the creek's beneficial uses. In addition, anticipated pH and turbidity conditions in Deer Creek under the proposed site-specific objectives would differ only slightly and occasionally from pH and turbidity conditions under compliance with the current Basin Plan objectives for these parameters. The slight and occasional difference that could occur in creek pH and turbidity between the proposed and current pH objectives would not adversely affect any of the creek's beneficial uses. The proposed site-specific Basin Plan amendments would have **less-than-significant impacts** to water quality.

9.6 CUMULATIVE IMPACT ANALYSIS FOR THE PROPOSED PROJECT

Cumulative impacts refer to one or more individual effects which, when taken together, are considerable or which compound or increase other environmental impacts. Such effects result from the incremental impact of a project when added to other closely related past, present, and reasonably foreseeable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time.

Staff is currently working on making a recommendation for a site-specific Basin Plan amendment for Deer Creek temperature objectives. The proposed temperature amendment is anticipated to be processed within a few months of the pH and turbidity amendments proposed herein.

Like the proposed site-specific objectives for Deer Creek pH and turbidity, the proposed site-specific temperature objective will be developed to protect and maintain Deer Creek's aquatic biological resources and other beneficial uses. There is no anticipated circumstance where impacts of pH and turbidity objectives could cumulate with impacts of the new temperature objectives currently being formulated. There are no circumstances that can reasonably be forecast for the unique combination of environmental conditions in the affected area under which the combination of pH, turbidity, and temperature objectives would collectively cause a significant adverse cumulative impact to Deer Creek aquatic life or any other environmental resource.

Any future development projects in the affected area would be required to comply with the proposed site-specific pH and turbidity objectives to the extent they are applicable. Accordingly, the impacts of individual development projects could not cumulate with the impacts of amending the pH and turbidity objectives applicable to Deer Creek. The

Proposed Project would not have an incremental effect or a cumulatively considerable incremental effect on identified resources in light of any development projects.

9.7 THE NO PROJECT/CURRENT BASIN PLAN ALTERNATIVE

This Staff Report concludes that the Proposed Project will not cause any potentially significant impacts. Therefore, there are no mitigation measures or alternative that could reduce or avoid significant impacts. This report analyzes a No Project/Current Basin Plan Alternative to provide additional context for decision-making parties. The No Project/Current Basin Plan Alternative is not environmentally superior to the Proposed Project.

The No Project/Current Basin Plan Alternative characterizes what would happen if the Proposed Project (i.e., site-specific Basin Plan amendments for Deer Creek pH and turbidity) is not approved and implemented. Under the No Project/Current Basin Plan Alternative, staff have identified three options that the District could, theoretically, implement to comply with the current Basin Plan objectives for receiving water pH and turbidity. These options are:

Option 1 – Additional Treatment Facilities;

Option 2 – Effluent Reuse; and

Option 3 – Connect to Sacramento Regional Wastewater Treatment Plant (SRWTP).

Detailed descriptions of each option and their respective implementation considerations and environmental impacts are discussed in the following subsections. A summary comparison of the Proposed Project to each of the three options under the No Project/Current Basin Plan Alternative is provided in **Table 5** and **Table 6** (below). These discussions focus on how the three options differ from the Proposed Project, and do not reiterate the impacts and considerations of each option that are comparable to those of the Proposed Project.

Table 5. Comparison of environmental impacts under the Proposed Project to those identified for each of the three options associated with the No Project/Current Basin Plan Alternative.

Resource Category	Proposed Project	No Project/Current Basin Plan Alternative Option 1 (Add. Trt. Facil.)	 Option 2 (Effl. Reuse)	 Option 3 (SRWTP)
Aesthetics	LTS	No Impact	**Significant:** Project-specific and cumulative for Deer Creek	**Significant:** Project-specific and cumulative for Deer Creek
Agricultural Resources	No Impact	No Impact	No Impact	No Impact
Air Quality	No Impact	LTS	LTS	LTS
Biological Resources	LTS	LTS	**Significant:** Project-specific and cumulative for Deer Creek **Potentially Significant** Cumulative impact to region	**Significant:** Project-specific and cumulative for Deer Creek **Potentially Significant** Cumulative impact to region
Cultural Resources	No Impact	No Impact	LTS	LTS
Geology and Soils	No Impact	No Impact	No Impact	No Impact
Hazards and Haz. Materials	No Impact	LTS	LTS	No Impact
Hydrology	No Impact	No Impact	**Significant:** Project-specific and cumulative for Deer Creek • **Beneficial** for water bodies serving District water supplies	**Significant:** Project-specific and cumulative for Deer Creek • LTS for Sac. River
Land Use and Planning	No Impact	No Impact	No Impact	No Impact
Mineral Resources	No Impact	No Impact	No Impact	No Impact
Noise	No Impact	LTS	LTS	LTS
Population and Housing	No Impact	No Impact	No Impact	No Impact
Public Services	No Impact	No Impact	No Impact	No Impact
Recreation	No Impact	No Impact	**Significant:** Project-specific and cumulative for Deer Creek	**Significant:** Project-specific and cumulative for Deer Creek • LTS for Sac. River
Transportation/Traffic	No Impact	LTS	LTS	LTS
Utilities and Service Systems	No Impact	No Impact	No Impact	No Impact
Water Quality	LTS	LTS • **Pot. Sig.** Cumul. impact to Delta raw water supplies	• **Potentially Significant** direct and cumulative for Deer Creek • **Significant** for Bass Lake	**Potentially Significant** direct and cumulative for Deer Creek

Table 6. Comparison of implementation considerations and economic impacts to the District of implementing the Proposed Project versus each of the three options associated with the No Project/Current Basin Plan Alternative.

Issue	Proposed Project	No Project/Current Basin Plan Alternative		
		Option 1 (Add. Trt. Facil.)	**Option 2 (Effl. Reuse)**	**Option 3 (SRWTP)**
Implementation Considerations	• Approval of proposed SSBPAs • Modification of NPDES permit to be consistent w/ amended Basin Plan • Would resolve current regulatory problems associated w/ Deer Creek pH and turbidity	• Design and construction of additional facilities • Operation of additional facilities • Would resolve current regulatory problems associated w/ Deer Creek pH and turbidity	• Addressing the conditions of SWRCB Order WR 95-9, or obtain a further Order from the SWRCB • Use of Bass Lake as a recycled water storage reservoir • Need for off-site construction activities • Significant environmental impacts to be mitigated • May not fully resolve current regulatory problems associated w/ Deer Creek pH and turbidity	• Addressing the conditions of SWRCB Order WR 95-9, or obtain a further Order from the SWRCB • Agreement with SRWTP • Need for off-site construction activities • Significant environmental impacts to be mitigated • Would resolve current regulatory problems associated w/ Deer Creek pH and turbidity
Direct Capital Cost to District	$0.5 million	$5.9 million	$18 million	$38-52 million
Direct Cost to Other Parties	none	none	none	none

9.7.1 Option 1 – Additional Treatment Facilities

9.7.1.1 Description

Under Option 1 (Additional Treatment Facilities), the District's physical plant facilities and operations would be modified to comply with the current NPDES permit pH and turbidity limitations, which are based on current Basin Plan water quality objectives. A description of these additional facilities is provided below.

9.7.1.1.1 Additional Facilities for Current pH Objective Compliance

In order to comply with the current Basin Plan water quality objective for pH, additional chemical-feed facilities would be constructed. pH control would be achievable by providing chemical addition to the effluent just prior to discharge from the plant. For purposes of this analysis, it was assumed that sodium hydroxide (NaOH) would be used, thereby allowing use of DCWWTP's existing chemical storage tank. The added components would include (OEMC 1998):

- one chemical storage tank;
- two chemical feed pumps with assorted piping;
- control systems for monitoring and controlling chemical dosage; and
- on-line pH monitoring with feedback controls.

The capital costs associated with the additional facilities for pH control would be approximately $200,000 (OEMC 1998). The associated annual operating and maintenance (O&M) costs would be approximately $56,000 per year (OEMC 1998).

Providing pH control on a seasonal basis would essentially result in the same capital cost (i.e., $200,000) (OEMC 1998). The pumps would be somewhat smaller, but the cost variance would be within the tolerance of the preliminary estimate. O&M costs would be less, because less chemical would be used, however, basic maintenance of the equipment would be the same, as there is an amount of maintenance necessary simply to keep chemical systems in operational readiness throughout the year (OEMC 1998).

9.7.1.1.2 Additional Facilities for Current Turbidity Objective Compliance

Additional filtration facilities would be required to ensure that DCWWTP discharges comply with the current Basin Plan turbidity objective of no receiving water increase more than 1 NTU when the ambient turbidity is between 0 and 5 NTUs. Because Deer Creek is effluent-dominated for much of the year, and receiving water turbidities can be less than 0.20 NTUs throughout the summer/fall period, the effluent would essentially have to be 1 NTU or less throughout the summer/fall period of the year to ensure compliance. The source of the following design information is "Basis of Design Report for Compliance with 1997 Permit" (OEMC 1998).

New filters would need to be constructed to eliminate bypassing of secondary effluent during peak flow conditions. The existing wastewater filtration system has a design capacity of approximately 3.6 mgd. At flows beyond 3.6 mgd, secondary effluent is currently bypassed to a 1 mgd tank until it can be put through the filters prior to disinfection. Additional filters would eliminate this bypass and permit all secondary effluent to be filtered prior to entering the disinfection basins. The new tertiary filters will be designed to process most of the wastewater flows, enabling the existing tertiary and reclaimed wastewater filters to provide standby service during a peak flow event, as well as having units out of service for backwashing and maintenance.

A filtration facility consisting of additional filters would provide the ideal size and complement of existing filters to process the seasonally wide-ranging wastewater flows expected at the Deer Creek facility

Secondary effluent from the clarifiers is distributed to the existing filtration system by a flow-splitting box. Secondary wastewater does enter the flow-splitting box through pipelines. Secondary effluent flow into the filtration system is controlled by adjustable upward-acting weir gates located on the splitter-box.

Chemical coagulants would be applied to the secondary effluent to improve filtration performance. These coagulants, consisting of either aluminum sulfate (alum) or an organic polymer, would be added at two optional locations. Facilities would be provided to feed liquid alum or polymer to the inlet or outlet to the clarifiers. The chemical feed pumps would be located adjacent to the filters and clarifiers and chemical feed lines extended to the point of application. Storage tanks would be used to store coagulants. One tank would be used to store liquid alum and the second would contain liquid polymer.

A master filter control panel would be located within the filter control center. This control panel would include all the necessary instrumentation and controls to provide continuous operation of the filters, including automatic surface washing and backwashing of the filters during the cleaning cycle

Seasonal consideration for meeting turbidity presents an unusual flow situation that is somewhat difficult to meet. The existing filters are not sufficient in size and capacity to meet the wettest "dry month." In other words, if May or June were relatively wet compared to other May-June combinations, the plant flows would be high enough to require a significant number of filters. Therefore, additional filters would be necessary. Another alternative would be to build influent equalization utilizing 2.5 million gallons (MG) of tank storage onsite.

In order to provide the filters for seasonal turbidity control, flow split, pipes, foundations and structures for previously mentioned filters would be built. In this option, filter sizes would be limited to average wet weather flows, but basically be built in accordance with the previous discussion. Most of the expensive components have to be constructed. Therefore, the capital savings are limited.

The capital costs associated with the additional facilities (i.e., additional filters and related facilities) for preventing receiving water increases of more than 1 NTU would be approximately $6,000,000. The capital costs associated with meeting the current 1 NTU when the creek is flowing at its summer base flow of 0.16-0.28 mgd (0.25-0.43 cfs) (SWRCB 1995) and its turbidity is at levels below 0.5 NTU would require microfiltration at considerably higher construction costs.

9.7.1.2 Implementation Considerations

Implementation of this option to meeting the current Basin Plan objectives for pH and turbidity, and related NPDES permit requirements, would not require any additional regulatory actions. This option would require the District to incur approximately $6 million in facility upgrades to comply with the current requirements.

9.7.1.3 Environmental Impacts

Option 1 (Additional Treatment Facilities) of the No Project/Current Basin Plan Alternative would not eliminate any significant adverse impacts of the Proposed Project because there are none. Potential environmental impacts of implementing Option 1 of the No Project/Current Basin Plan Alternative would fall into two main categories: 1) short-term, construction-related impacts; and 2) long-term, operations-related impacts. Based on the above discussions, it can be reasonably concluded that both short-term construction and long-term operational activities associated with this option would have no impacts on the following resources:

- Aesthetics;
- Agricultural Resources;
- Cultural Resources;
- Geology and Soils;
- Hydrology;
- Land Use and Planning;
- Mineral Resources;
- Population and Housing;
- Public Services;
- Recreation; and
- Utilities and Service Systems.

Conversely, construction-related activities associated with Option 1 of the No Project/Current Basin Plan Alternative could potentially have temporary impacts to:

- Air Quality;
- Noise; and
- Transportation/Traffic.

Furthermore, operations of and discharge of effluent from the modified DCWWTP facility under Option 1 of the No Project/Current Basin Plan Alternative could potentially have long-term impacts to:

- Biological Resources;
- Hazards and Hazardous Materials;
- Transportation/Traffic; and
- Water Quality.

Potential short-term construction-related impacts and long-term impacts resulting from Option 1 of the No Project/Current Basin Plan Alternative are discussed separately below.

9.7.1.3.1 Construction-related Impacts

To consistently comply with the current Basin Plan objectives for pH and turbidity under Option 1 of the No Project/Current Basin Plan Alternative, construction and operation of new facilities at DCWWTP would be required. See Section 9.7.1.1 for a detailed description of these facilities. Because all necessary facilities would be constructed within the current site plan or "footprint" of DCWWTP, no expansion of the existing site plan would be necessary. As such, no off-site land disturbances or clearing would occur. In addition, construction best management practices (BMPs) would be implemented to minimize and/or avoid impacts to resources resulting from on-site activities. Consequently, potential construction-related impacts to all resource categories would be de minimus or completely avoided, with the possible exceptions of impacts to air quality, noise, and transportation/traffic.

Potential air quality, noise, and transportation/traffic impacts are all associated with transportation of workers, equipment, and supplies to and from the site, and operation of equipment on-site during the construction period. These transportation and construction activities would temporarily increase local traffic and noise levels, particularly within several miles of the plant site. Increased traffic levels could, foreseeably, increase environmental exposure to hazardous materials (e.g., fuels, oils, lubricants, etc.). Construction BMPs would be implemented to minimize air quality, noise, and transportation/traffic impacts. Because BMPs would be implemented and because effects on these resource areas would be temporary, construction-related impacts to air quality, noise, and transportation/traffic under Option 1 of the No Project/Current Basin Plan Alternative would be less-than-significant.

9.7.1.3.2 Operations-related Impacts

9.7.1.3.2.1 Biological Resources

Operations under Option 1 of the No Project/Current Basin Plan Alternative would result in a slight a reduction in downstream turbidity levels during some times when natural creek turbidities are less than 2 NTUs. However, this slight and occasional decrease in creek turbidity under such conditions would not result in any measurable benefit to the biological resources of Deer Creek.

In addition, Option 1 operations would add sodium hydroxide to the effluent to maintain higher effluent pH levels to comply with the Basin Plan's "delta 0.5-unit" requirement. The effects on Deer Creek's aquatic and riparian plants of adding this salt to the effluent are unknown. The anticipated salt addition would not be expected to adversely affect the creek's aquatic macroinvertebrates, fish, reptiles, amphibians, or the terrestrial wildlife using Deer Creek's riparian corridor.

The higher pH maintained in Deer Creek under the Option 1 of the No Project/Current Basin Plan Alternative would place aquatic macroinvertebrates and fish residing downstream of the DCWWTP at higher risk of ammonia toxicity. Although the DCWWTP is a fully nitrifying plant, all plants have periodic upsets/operational difficulties that can result in the plant temporarily falling out of complete nitrification. Until complete nitrification was restored at the plant, the effluent discharged to the creek would be expected to contain some level of ammonia. At the higher pH levels maintained under Option 1 of the No Project/Current Basin Plan Alternative, the potential for ammonia-induced stress or even toxicity to downstream macroinvertebrates and fish under such conditions would be increased, relative to the existing condition or those under the Proposed Project, because of the higher effluent pH maintained. A greater percentage of total ammonia is present in the toxic un-ionized form at higher pH levels, relative to lower pH levels, all else being equal. Nevertheless, conditions when the DCWWTP effluent would contain measurable levels of ammonia would occur only under certain plant-upset conditions and, therefore, would be expected to occur very infrequently.

Overall, effluent quality under Option 1 of the No Project/Current Basin Plan Alternative would be expected to have less-than-significant impacts to Deer Creek's aquatic biota, reptiles, amphibians, and other associated biological resources. As such, it would be expected to have less-than-significant impacts to Cosumnes River biological resources as well.

Based on the above discussion, Option 1 of the No Project/Current Basin Plan Alternative would be expected to have less-than-significant impacts to biological resources in, and associated with, Deer Creek and downstream water bodies.

9.7.1.3.2.2 Hazards and Hazardous Materials

As discussed under Section 9.7.1.1, implementation of Option 1 of the No Project/Current Basin Plan Alternative would require additional transport and storage of chemicals at the DCWWTP, relative to existing conditions and conditions under the Proposed Project. However, based on the relative degree of additional transportation and storage required and the specific chemicals involved, this would constitute a less-than-significant impact.

9.7.1.3.2.3 Transportation/Traffic

Under Option 1 of the No Project/Current Basin Plan Alternative, additional deliveries of chemicals to the plant site would be required compared to existing conditions or conditions under the Proposed Project. However, the relative percent increase in trucking traffic anticipated would constitute a less-than-significant impact.

9.7.1.3.2.4 Water Quality

Operation of the DCWWTP under Option 1 of the No Project/Current Basin Plan Alternative would result in slight positive and negative effects on downstream water quality, relative to existing conditions and conditions under the Proposed Project.

The positive effect to water quality that would occur would be a slight reduction in downstream turbidity levels during some times when natural creek turbidities are less than 2 NTUs. However, this slight and occasional decrease in creek turbidity under such conditions is not expected to result in any measurable benefit to environmental resources.

The negative effect to Deer Creek water quality would include an increase in downstream total dissolved solid (TDS) concentrations resulting from the addition of a salt (sodium hydroxide) to the final effluent to facilitate compliance with the current Basin Plan's "delta 0.5-unit" pH requirement. Delta water purveyors have identified total TDS as one of their primary concerns regarding the quality of municipal and industrial water supplies diverted from the Delta. Through comments at stakeholder workshops held for the SRWTP 2020 Master Plan EIR, Delta water purveyors (e.g., California Urban Water Agencies, Contra Costa Water District, Metropolitan Water District) indicated they would consider additional loading of TDS (i.e., salts) to the system from upstream point source discharges, particularly SRWTP, as a significant impact to their raw water supplies. Although seawater intrusion is the primary factor affecting the salinity of Delta waters, runoff, treated wastewater discharges, and agricultural drain return water also can influence Delta TDS levels.

Because the additional loading of salts from the DCWWTP under Option 1 of the No Project/Current Basin Plan Alternative would be minor in the context of Delta TDS levels, and would not be expected to measurably affect Delta TDS levels relative to existing conditions or conditions under the Proposed Project, this impact to downstream water quality is considered to be less than significant. Nevertheless, it would incrementally contribute to an already adverse Delta water quality condition. No other aspect of DCWWTP operations under Option 1 of the No Project/Current Basin Plan Alternative would be expected to adversely affect Deer Creek water quality, or the water quality of downstream water bodies.

Overall, operations of the DCWWTP under Option 1 of the No Project/Current Basin Plan Alternative would constitute a less-than-significant impact to water quality.

9.7.2 Option 2 - Effluent Reuse

9.7.2.1 Description

Under the Option 2 (Effluent Reuse), the District would reuse effluent produced at the DCWWTP facility, thereby eliminating effluent discharge to Deer Creek, throughout the irrigation season as a means of complying with the current Basin Plan pH and turbidity objectives. This alternative would require the following facilities (HDR 2002):

- Tertiary filters to treat total annual flow during the irrigation season. The filter plant would have to be approximately 10 firm mgd capacity.
- Pipelines to the seasonal storage.
- Seasonal storage of approximately 1,700 ac ft.
- Distribution piping to reuse users.

The capital cost associated with Option 2 would be approximately $18 million.

9.7.2.2 Implementation Considerations

Two factors would affect the feasibility of completely reusing the wastewater stream and eliminating discharges to Deer Creek: available market for sale of reuse water; and the regulatory ability of the District to eliminate discharges to Deer Creek and treat the effluent for resale.

9.7.2.2.1 Market for Reuse Water

Potential uses for reuse wastewater in El Dorado County are irrigation uses for greenbelts, golf courses, playgrounds, and parks as well as some small industrial uses, dual water systems for new developments, and agricultural uses. These potential uses were delineated in HDR's "Recycled Water Master Plan" (2002).

Irrigation uses generally occur during the period May through October. This reuse period would not coincide with the period during which DCWWTP has experienced compliance issues on Deer Creek, which is May through December. So the Effluent Reuse option would not be considered a fully viable option to developing site-specific amendments for Deer Creek.

9.7.2.2.2 Regulatory Issues

The State Board issued Order WR 95-9, which imposes a condition on the State Board's approval of the District's treated wastewater change petition WW-20 requiring DCWWTP to discharge a minimum flow of 0.5 or 1 mgd to Deer Creek, depending on the quantity of treated wastewater that is produced. Modifying this condition would require the District to relinquish the approval of Order WR 95-9, or a subsequent order from the State Board. Order WR 95-9 states that the purpose of this condition of approval is to protect the stream environment created by the wastewater discharge (SWRCB 1995). A second regulatory issue relates to the ability to use Bass Lake as a reuse storage reservoir. Finally, this option may not fully resolve the current regulatory problems associated with Deer Creek pH and turbidity

9.7.2.3 Environmental Impacts

Implementation of Option 2 (Effluent Reuse) of the No Project/Current Basin Plan Alternative would not eliminate any significant adverse impacts of the Proposed Project because there are none.

Potential environmental impacts associated with Option 2 also would fall into two main categories: 1) short-term, construction-related impacts; and 2) long-term, operations-related impacts. Based on the above discussions, it can be reasonably concluded that both short-term construction and long-term operational activities associated with Option 2 of the No Project/Current Basin Plan Alternative would have no impacts to the following resources:

- Agricultural Resources;
- Geology and Soils;
- Land Use and Planning;
- Mineral Resources;
- Population and Housing;
- Public Services; and

- Utilities and Service Systems.

Conversely, construction-related activities associated with Option 2 of the No Project/Current Basin Plan Alternative could potentially have impacts to:

- Air Quality;
- Noise;
- Cultural Resources; and
- Transportation/Traffic.

Furthermore, operations of the additional reuse facilities under Option 2 of the No Project/Current Basin Plan Alternative could potentially have long-term impacts to:

- Aesthetics;
- Biological Resources;
- Hazards and Hazardous Materials;
- Hydrology;
- Recreation; and
- Water Quality.

Potential short-term construction-related impacts and long-term impacts resulting from Option 2 of the No Project/Current Basin Plan Alternative are discusses separately below.

9.7.2.3.1 <u>*Construction-related Impacts*</u>

To consistently comply with the current Basin Plan objectives for pH and turbidity under Option 2 of the No Project/Current Basin Plan Alternative, construction and operation of new facilities at DCWWTP, and elsewhere off site, would be required. See Section 9.7.2.1 for a detailed description of these facilities. The construction of an onsite storage tank and pump at DCWWTP would be within the existing site plan of the plant. On-site construction activities would be conducted in a manner (i.e., using BMPs, etc.) that would result in less-than-significant impacts to local and onsite resources. Some of the necessary facilities would be constructed outside the current site plan or “footprint” of DCWWTP. As such, off-site land disturbances and/or clearing would occur (e.g., pipeline routes). Construction BMPs would be implemented to minimize and/or avoid impacts to resources resulting from both on-site and off-site construction activities. Consequently, potential construction-related impacts to all resource categories would be reduced to less-than-significant levels or completely avoided, with the possible exceptions of impacts to air quality, cultural resources, noise, and transportation/traffic.

Potential air quality, noise, and transportation/traffic impacts are all associated with transportation of workers, equipment, and supplies to and from construction sites, and operation of equipment both on- and off-site during the construction period. These transportation and construction activities would temporarily increase local air pollution, traffic, and noise levels, particularly within several miles of construction areas. Increased traffic levels could, foreseeable, increase environmental exposure to hazardous materials (e.g., fuels, oils, lubricants, etc.). Construction BMPs would be implemented to minimize air quality, noise, and transportation/traffic impacts. Because BMPs would be implemented and because effects on these resource areas would be temporary, construction-related impacts to air quality, noise, and transportation/traffic under Option 2 of the No Project/Current Basin Plan Alternative would be less than significant.

9.7.2.3.1.1 Cultural Resources

Option 2 of the No Project/Current Basin Plan Alternative would involve placement of reuse pipelines and other off-site construction activities. These activities have the potential to adversely affect buried cultural resources, pending the exact routing of pipelines and locations determined for other construction activities. However, because necessary construction BMPs and best possible routing of pipelines would be expected to be implemented to minimize or avoid impacts to buried artifacts and other cultural resources, this impact is considered to be less than significant.

9.7.2.3.2 Operations-related Impacts

9.7.2.3.2.1 Aesthetics

As a means of compliance with the current Basin Plan objectives for pH and turbidity, Option 2 of the No Project/Current Basin Plan Alternative, proposes to eliminate discharge to the creek during the reuse period of the year (i.e., typically May through October). Some of the additional recycled water would be used to irrigate local golf courses greenbelts, and parks. Since people enjoy recreating on golf courses, greenbelt areas, and in parks, Option 2 of the No Project/Current Basin Plan Alternative could potentially contribute to improved aesthetics and recreational opportunities in these places.

Conversely, elimination of effluent discharges from the DCWWTP to Deer Creek during the May through October period would result in the following changes to Deer Creek:

- significantly reduced flows rates (SWRCB 1995);
- reduced amounts of downstream habitat for aquatic organisms (SWRCB 1995);
- elevated downstream water temperatures (because creeks having lower flows gain heat more rapidly during summer months, all else being equal);
- reduced acreage of riparian habitat and associated wildlife species utilizing the riparian corridor (SWRCB 1995); and
- fewer and shallower downstream pool habitats and associated reductions in swimming and boating opportunities.

Based on changes to Deer Creek (identified above), Option 2 of the No Project/Current Basin Plan Alternative would cause **significant** adverse impacts to the aesthetics and aesthetic enjoyment of Deer Creek, relative to existing conditions and conditions under the Proposed Project.

9.7.2.3.2.2 Biological Resources

SWRCB Order WR 95-9 states the following: returning Deer Creek to its natural state through elimination of effluent discharges from the DCWWTP to Deer Creek during the May through October period of the year would result in significant adverse changes to Deer Creek's aquatic and riparian habitats; ceasing effluent discharge during the summer season would negatively impact Deer Creek's aquatic biological resources; ceasing May through October effluent discharges to Deer Creek would significantly reduce the miles of wetted channel during these months of the year, downstream of the DCWWTP and, therefore, the number of miles of riparian habitat supported by the creek; and the aquatic habitat that would persist for a few miles below the DCWWTP would be substantially reduced in quality for sustaining fish populations and other aquatic communities (SWRCB 1995).

Ceasing effluent discharges to Deer Creek during the May through October period would cause Deer Creek to return to its natural state, under which surface flow continuity with the Cosumnes River would cease earlier in the year than it does now. Under Option 2, loss of surface flow continuity would probably occur in May/June compared to June/July under existing conditions and conditions under the Proposed Project. This would increase the chance that any steelhead, a species listed as threatened under the federal ESA, opportunistically produced in the creek under certain hydrologic and water temperature conditions would become isolated from downstream waters prior to the creek's average water temperatures reaching a level (e.g., about 68ºF) that would trigger juvenile steelhead emigration from the creek. Any juvenile steelhead isolated from downstream waters in spring would likely be lost due, either directly or indirectly, to thermal stress during the summer or fall period.

Finally, use of Bass Lake as a recycled water storage reservoir could adversely affect the lake's existing biological resources. While the reservoir now supports a population of warm water fish (bass, crappie, and bluegill), converting the reservoir to purely effluent storage with little dilution from the limited watershed runoff could result in fish mortality during periods of intense reclaimed water use and/or periods of low dissolved oxygen associated with large-scale plant die-offs. Eventually, the reservoir would become devoid of game fish species and could assume the water quality characteristics of a typical reclaimed water storage reservoir. These reservoirs support algae population densities many times those encountered in a typical surface water storage reservoir of similar morphology, and more variable water quality. Both of these factors could adversely affect the existing fish populations of the lake.

These adverse changes to Deer Creek and Bass Lake habitats under Option 2 of the No Project/Current Basin Plan Alternative would contribute to a **significant** adverse impact to area biological resources, relative to existing conditions and conditions under the Proposed Project.

9.7.2.3.2.3 Hazards and Hazardous Materials

As discussed under Section 9.7.2.1, implementation of Option 2 of the No Project/Current Basin Plan Alternative would require additional transport and storage of chemicals at the DCWWTP, relative to existing conditions and conditions under the

Proposed Project. However, based on the relative degree of additional transportation and storage required and the specific chemicals involved, this would constitute a less-than-significant impact.

9.7.2.3.2.4 Hydrology

Option 2 of the No Project/Current Basin Plan Alternative would have both positive and negative effects on regional hydrology.

Under Option 2, flow rates in Deer Creek would be significantly reduced during much of the May though October period, annually, relative to existing conditions and conditions under the Proposed Project. Effluent discharges from the DCWWTP constitute a major source of water to Deer Creek, downstream of the DCWWTP, during this period of the year. Moreover, this source of flow is critical to sustaining the creek's hydrology, groundwater recharge, and associated biological resources in downstream reaches, during the May through October period. Elimination of effluent discharges to Deer Creek during the may through October period under Option 2 of the No Project/Current Basin Plan Alternative would constitute a **significant** adverse impact to Deer Creek hydrology, relative to existing conditions and to conditions under the Proposed Project.

Conversely, increasing reuse under Option 2 could potentially have a positive impact on local water supplies. Increasing the amount of water reuse for agriculture, urban irrigation, and industrial use, could result in a decreased raw water supply demand for these uses. Reduced diversion demand could extend the capability of raw water supplies to meet other, more sensitive uses such as household uses. This could create more reliable, less expensive water supplies for local consumers. At the same time, expanded water supplies due to reuse could reduce the reliance on groundwater supplies, preventing groundwater overdraft. Likewise, on a larger scale, if the District requires less local water supplies due to increased water reuse, more supplies will be available for instream uses downstream of the Districts diversion locations. Option 2 of the No Project/Current Basin Plan Alternative would constitute a beneficial impact to District water supplies and the hydrology of the systems from which the District currently diverts its raw water supplies.

9.7.2.3.2.5 Recreation

As initially discussed under aesthetics (above), elimination of effluent discharges from the DCWWTP to Deer Creek during the May through October period would substantially reduce downstream Deer Creek flows, the amount and quality of both aquatic and riparian habitats, and swimming, boating, wading, and fishing opportunities during these months. Moreover, such changes would have adverse effects on the existing populations of organisms using the creek and its riparian corridor during this period of the year (SWRCB 1995).

The anticipated loss and degradation of instream and riparian habitats of Deer Creek would result in adverse effects on creek aesthetics and populations of aquatic and terrestrial organisms. Picnicking and wildlife viewing may be less rewarding due to lower water levels and subsequent reduction in aquatic biological communities. The substantially reduced flows would result in fewer and shallower downstream pool habitats and associated reductions in swimming, boating, wading, and fishing opportunities within the creek, downstream of the DCWWTP. These effects under Option 2 of the No Project/Current Basin Plan Alternative would cause **significant** adverse impacts to recreation in and along the creek, relative to existing conditions and conditions under the Proposed Project.

9.7.2.3.2.6 Water Quality

Option 2 of the No Project/Current Basin Plan Alternative would substantially reduce creek flows downstream of the DCWWTP by eliminating effluent discharge during the May through October period. This Option would be expected to have both positive and negative impacts to water quality, relative to existing conditions and conditions under the Proposed Project.

The positive impacts to water quality would include elimination of certain constituent loading to Deer Creek that result from discharging tertiary treated effluent. However, because constituent loading from the DCWWTP currently does not adversely affect downstream beneficial uses of the creek, reductions in current loadings may not provide demonstrable positive effects to any environmental resources or downstream beneficial uses.

Negative effects to water quality under Option 2 would include elevation in Deer Creek water temperatures in some downstream reaches during the summer and fall months, where flows would become very low. As stated previously, a creek having low flow gains heat more rapidly during the summer months than does a creek with higher flows, all else remaining the same. In addition, State Board Order WR 95-9 concluded that returning Deer Creek to its natural state by eliminating effluent discharge would create a potential for toxicity to fish due to decreased water quality, relative to existing conditions (SWRCB 1995).

Converting Bass Lake to a reclaimed water storage facility could potentially impact lake water quality due to nutrient loading associated with the storage of recycled water in the lake. This could result in algal blooms and macrophyte growth, which could further degrade lake water quality during times when large-scale plant die-off occurs. Copper sulfate treatment of Bass Lake could become necessary to control problem algal growth. This would load copper to the system, which, if performed regularly for prolonged periods, could degrade lake water quality and contribute to sediment copper toxicity.

Overall, SWRCB Order 95-9 states that elimination of effluent discharge to Deer Creek, which is proposed under Option 2 of the No Project/Current Basin Plan Alternative, would constitute a **potentially significant** impact to Deer Creek water quality, relative to existing conditions. Moreover, Option 2 would result in a **significant** impact to water quality of Bass Lake, relative to existing conditions.

9.7.3 Option 3 – Connect to SRWTP

9.7.3.1 Description

Under Option 3 (Connect to SRWTP), the District would maintain its current level of effluent recycling and re-route the remaining effluent and/or raw sewage to SRWTP via pipeline.

The facilities necessary to accomplish this option are to build pump stations and pipelines from Cameron Park to the available trunk line sewer locations. Two trunk line sewer options are viable (1) gravity flow via Deer Creek drainage course, and (2) pump and gravity flow via Folsom trunk lines.

9.7.3.1.1 Gravity

This option consists of a trunk line that SRWTP plans to build that follows the Deer Creek drainage course. The Deer Creek trunk line is scheduled to be complete in 16-18 years and will likely involve significant environmental scrutiny. If this option were selected, a gravity sewer would be built from the Deer Creek plant down the Deer Creek drainage plain to the terminus of the Sacramento trunk line.

9.7.3.1.2 Pumped and Gravity

The second option consists of a connection to the Sacramento County system in Folsom. Trunk lines have recently been built to service the city of Folsom. A pump station would be constructed in the vicinity of Cameron Park where the gravity sewers cross Highway 50. Some interconnecting sewers from the Sanitation District 2 system would have to be tied into the pump station. Sewage would be pumped along Highway 50 to El Dorado Hills, then diverted to follow the contours along White Rock Road to Prairie City Road, and then north to tie into the trunk sewer. The pump station would have to be able to pump the entire peak flow and would include standby power to assure compliance in the event of a power failure.

Costs for implementation of the Option 3, including both District facility costs and connection fees to SRWTP would be approximately $38 to 52 million. Facility costs would include the pump station and approximately 15 miles of sewer pipeline.

9.7.3.2 Implementation Considerations

Option 3 (Connection to SRWTP) would require the District to return Deer Creek to its natural state by eliminating all effluent discharges to the creek. This could not be accomplished absent addressing in some manner the conditions of Order WR 95-9, or obtaining a further order from the SWRCB eliminating the condition requiring minimum effluent discharges from DCWWTP to Deer Creek. If year-round discharges to Deer Creek cannot be ceased, this option would be infeasible. In addition, the District would have to be annexed, or execute an agreement with the Sacramento County Regional Sanitation District (SRCSD) to transport and treat sewage. SCRSD has indicated that a facility connection fee would have to be paid, similar to any other customer.

9.7.3.3 Environmental Impacts

Implementation of Option 3 (Connection to SRWTP) of the No Project/Current Basin Plan Alternative would not eliminate any significant adverse impacts of the Proposed Project because there are none.

Potential environmental impacts associated with Option 3 also would fall into two main categories: 1) short-term, construction-related impacts; and 2) long-term, operations-related impacts. Based on the above discussions, it can be reasonably concluded that both short-term construction and long-term operational activities associated with Option 3 of the No Project/Current Basin Plan Alternative would have **no impacts** to the following resources:

- Agricultural Resources;
- Geology and Soils;
- Hazards and Hazardous Materials;
- Land Use and Planning;
- Mineral Resources;
- Population and Housing;
- Public Services; and
- Utilities and Service Systems.

Conversely, construction-related activities associated with Option 3 (Connect to SRWTP) of the No Project/Current Basin Plan Alternative could potentially have impacts to:

- Air Quality;
- Noise;
- Cultural Resources; and
- Transportation/Traffic.

Furthermore, additional discharge of secondary treated effluent from the SRWTP facility into the Sacramento River, rather than discharge of tertiary treated effluent into Deer Creek, under Option 3 could potentially have long-term impacts to:

- Aesthetics;
- Biological Resources;
- Hydrology;
- Recreation; and
- Water Quality.

Potential short-term construction-related impacts and long-term impacts resulting from Option 3 (Connect to SRWTP) of the No Project/Current Basin Plan Alternative are discusses separately below.

9.7.3.3.1 Construction-related Impacts

To consistently comply with the current Basin Plan objectives for pH and turbidity under Option 3 (Connect to SRWTP) of the No Project/Current Basin Plan Alternative, the influent from the Deer Creek service area would be routed to SRWTP for treatment and discharge to the Sacramento River. This option would eliminate discharge to Deer Creek year-round. Construction and operation of new facilities at DCWWTP, and elsewhere off site, would be required. See Section 9.7.3.1 (above) for a detailed description of these facilities.

On-site construction activities would be conducted in a manner (i.e., using BMPs, etc.) that would result in less-than-significant impacts to local and onsite resources. Some of the necessary facilities (e.g., pipelines) would be constructed outside the current site plan or "footprint" of DCWWTP. As such, off-site land disturbances and/or clearing would occur. Construction BMPs would be implemented to minimize and/or avoid impacts to resources resulting from both on-site and off-site construction activities. Consequently, potential construction-related impacts to all resource categories would be reduced to less-than-significant levels or completely avoided, with the possible exceptions of impacts to air quality, cultural resources, noise, and transportation/traffic.

Potential air quality, noise, and transportation/traffic impacts are all associated with transportation of workers, equipment, and supplies to and from construction sites, and operation of equipment both on- and off-site during the construction period. These transportation and construction activities would temporarily increase air pollution, local traffic, and noise levels, particularly within several miles of construction areas. Increased traffic levels could, foreseeably, increase environmental exposure to hazardous materials (e.g., fuels, oils, lubricants, etc.). Construction BMPs would be implemented to minimize air quality, noise, and transportation/traffic impacts. Because BMPs would be implemented and because effects on these resource areas would be temporary, construction-related impacts to air quality, noise, and transportation/traffic under Option 3 of the No Project/Current Basin Plan Alternative would be **less-than-significant.**

9.7.3.3.1.1 Cultural Resources

Option 3 (Connect to SRWTP) of the No Project/Current Basin Plan Alternative would involve placement of collection system pipelines and other off-site construction activities. These activities have the potential to adversely affect buried cultural resources, pending the exact routing of pipelines and locations determined for other construction activities (e.g., interceptors). However, because necessary construction BMPs and best possible routing of pipelines would be expected to be implemented to minimize or avoid impacts to buried artifacts and other cultural resources, this impact is considered to be **less than significant.**

9.7.3.3.2 Operations-related Impacts

9.7.3.3.2.1 Aesthetics

As a means of compliance with the current Basin Plan objectives for pH and turbidity, Option 3 (Connect to SRWTP) of the No Project/Current Basin Plan Alternative proposes to eliminate discharge to Deer Creek year-round. DCWWTP service area influent would be routed to the SRWTP for treatment and discharge as secondary effluent to the Sacramento River. Elimination of effluent discharges from the DCWWTP to Deer Creek during the late spring, summer, and early fall periods (e.g., May through October) would result in the following changed to Deer Creek:

- significantly reduced flows rates (SWRCB 1995);
- reduced amounts of downstream habitat for aquatic organisms (SWRCB 1995);
- elevated downstream water temperatures (because creeks having lower flows gain heat more rapidly during summer months, all else being equal);
- reduced acreage of riparian habitat and associated wildlife species utilizing the riparian corridor (SWRCB 1995); and
- fewer and shallower downstream pool habitats and associated reductions in swimming and boating opportunities.

No impacts to aesthetics would be expected due to ceasing effluent discharge during the winter period, because precipitation-derived runoff constitutes the primary source of instream flows during the winter/early spring precipitation period of the year. Hence, reductions in creek flows under Option 3 during the precipitation period of the year would generally be rather minor.

Based on changes to Deer Creek that would primarily occur during the summer and fall periods, Option 3 (Connect to SRWTP) of the No Project/Current Basin Plan Alternative would cause **significant adverse impacts** to the aesthetics and aesthetic enjoyment of Deer Creek, relative to existing conditions and conditions under the Proposed Project.

9.7.3.3.2.2 Biological Resources

Elimination of effluent discharges from the DCWWTP to Deer Creek throughout the year would result in significant adverse changes to Deer Creek's aquatic and riparian habitats, relative to existing conditions, as discussed under the aesthetics section (above) and in State Board Order WR 95-9 (SWRCB 1995), which imposes a condition to approval of the District's treated wastewater change petition WW-20 requiring minimum effluent discharges to Deer Creek. Order WR 95-9 states that the condition was imposed to protect and maintain Deer Creek's aquatic and riparian communities fostered, in part, by DCWWTP effluent discharges. Ceasing effluent discharge to the creek throughout the year would negatively impact Deer Creek's aquatic biological resources in downstream reaches, relative to existing conditions and conditions under the Proposed Project. Ceasing summer and fall discharges to Deer Creek would be expected to significantly reduce the miles of wetted habitat present during these periods of the year, downstream of the DCWWTP and, therefore, the number of miles of riparian habitat supported by the creek (SWRCB 1995). Moreover, the aquatic habitat that would persist for a few miles below the DCWWTP during summer and fall would be substantially reduced in quality for sustaining fish populations and other aquatic communities (SWRCB 1995).

Ceasing effluent discharges to Deer Creek throughout the year also would cause Deer Creek to loose surface flow continuity with the Cosumnes River earlier in the year. Under Option 3, loss of surface flow continuity would probably occur in May/June compared to June/July under existing conditions and conditions under the Proposed Project. This would increase the chance that any steelhead, a species listed as threatened under the federal ESA, potentially produced in the creek would become isolated from downstream waters prior to the creek's average water temperatures reaching a level (e.g., about 68^{o}F) that would trigger juvenile steelhead emigration from the creek. Any juvenile steelhead isolated from downstream waters in spring would likely be lost due, either directly or indirectly, to thermal stress during the summer or fall period.

Finally, option 3 (Connect to SRWTP) would result in additional discharge of secondary treated effluent from the SRWTP to the Sacramento River. As such, it would further contribute to constituent loadings to the river. The Sacramento River is 303(d) listed as an impaired water body due to elevated mercury levels and unknown toxicity. Increasing effluent discharged from this facility could possibly exacerbate any potential adverse effects of water quality on Sacramento River biological resources – both in the mixing zone and farther downstream.

These adverse changes to Deer Creek and the Sacramento River under Option 3 of the No Project/Current Basin Plan Alternative would contribute to a **significant** adverse impact to area biological resources, relative to existing conditions and conditions under the Proposed Project.

9.7.3.3.2.3 Hydrology

Under Option 3 (Connect to SRWTP), effluent discharges to Deer Creek would cease year-round. Hence, flow rates in Deer Creek, downstream of the DCWWTP, would be significantly reduced during much of the late spring, summer, and fall periods of the year, annually, relative to existing conditions and conditions under the Proposed Project. Effluent discharges from the DCWWTP constitute a major source of water to Deer Creek, downstream of the DCWWTP, during these periods of the year. Moreover, this source of flow is critical to sustaining the creek's instream flows, groundwater recharge, and associated biological resources, during these periods.

Precipitation events and related runoff dominate flows during the winter season. Frequent precipitation events saturate the streambed and surrounding soils so that precipitation rates exceed infiltration rates, resulting in increased runoff and stream flows. Effluent discharges have a much lesser contribution to stream flows during the winter season. Therefore, ceasing effluent discharges to Deer Creek during the winter season precipitation season would be expected to have much lesser effects on Deer Creek hydrology compared to ceasing discharges during the summer and fall period of the year.

Based on the above discussion, elimination of effluent discharges to Deer under Option 3 (Connect to SRWTP) of the No Project/Current Basin Plan Alternative would constitute a **significant** adverse impact to Deer Creek hydrology, relative to existing conditions and relative to conditions under the Proposed Project.

Because of the small volume of influent routed from the DCWWTP to the SRWTP, relative to SRWTP influent flows and Sacramento River flows, treatment and discharge of Deer Creek service area effluent to the Sacramento River would have **less-than-significant** impacts on Sacramento River hydrology.

9.7.3.3.2.4 Recreation

As initially discussed under aesthetics (above), elimination of effluent discharges from the DCWWTP to Deer Creek would substantially reduce downstream Deer Creek flows during the late spring, summer, and fall periods. This would decrease the amount and quality of both aquatic and riparian habitats, and swimming, boating, wading, and fishing opportunities during summer and fall months, relative to existing conditions. Moreover, such changes would have adverse effects on the existing populations of organisms using the creek and its riparian corridor during this period of the year, relative to existing conditions (SWRCB 1995). Since little recreational activity occurs during the winter, no impacts to recreation would be expected due to ceasing effluent discharge during the winter period.

The anticipated loss and degradation of instream and riparian habitats of Deer Creek would result in adverse effects on creek aesthetics and populations of aquatic and possibly terrestrial organisms. Picnicking and wildlife viewing may be less rewarding due to lower water levels and subsequent reduction in aquatic and riparian biological communities. The substantially reduced flows would result in fewer and shallower downstream pool habitats and associated reductions in swimming, boating, wading, and fishing opportunities within the creek, downstream of the DCWWTP, relative to existing conditions. These effects under Option (Connect to SRWTP) 3 of the No Project/Current Basin Plan Alternative would cause **significant adverse** impacts to recreation in and along the creek, relative to existing conditions and conditions under the Proposed Project.

Because the additional influent routed to SRWTP under this option would constitute a very minor percentage (e.g., <2%) of SRWTP's current influent, and because the Sacramento River provides a high level of dilution, its treatment and discharge to the Sacramento River would have **less-than-significant** impacts to recreation in and along the Sacramento River.

9.7.3.3.2.5 Water Quality

Option 3 (Connect to SRWTP) of the No Project/Current Basin Plan Alternative would substantially reduce Deer Creek flows during the late spring, summer, and fall periods, downstream of the DCWWTP, by eliminating effluent discharge to the creek, year-round. This Option would be expected to have both positive and negative impacts to water quality, relative to existing conditions and relative to conditions under the Proposed Project.

The positive impacts to water quality would include elimination of certain constituent loading to Deer Creek that results from discharging tertiary treated effluent. However, because constituent loading from the DCWWTP currently does not adversely affect downstream beneficial uses of the creek, reductions in current loadings would not provide demonstrable positive effects to any environmental resources or downstream beneficial uses.

Negative effects to water quality under Option 3 would include elevation in Deer Creek water temperatures in some downstream reaches during the summer and fall months, where flows would become very low. This would occur because a creek having low flow gains heat more rapidly during the summer months than does a creek with higher flows, all else remaining the same. Elevated water temperatures in some reaches of the creek could have adverse impacts to fish and benthic macroinvertebrate populations using these reaches. In addition, State Board Order WR 95-9 concluded that reduction in current surface flows in Deer Creek would create a potential for toxicity to fish due to decreased water quality, relative to existing conditions (SWRCB 1995).

A second negative effect to water quality would result from discharging the Deer Creek service area effluent to the Sacramento River as secondary effluent under this option, versus discharging the same influent as tertiary treated effluent into Deer Creek as occurs under existing conditions and as would occur under the Proposed Project. Albeit to a very small degree, this would incrementally increase constituent loadings (e.g., suspended solids, solid-adsorbed contaminants, etc.) to the Delta because of the lower levels of treatment, all else being the same.

Overall, operations under Option 3 (Connect to SRWTP) of the No Project/Current Basin Plan Alternative would constitute a **Potentially significant** impact to water quality, relative to existing conditions and conditions under the Proposed Project.

9.7.4 Cumulative Impacts Of The No Project Alternative Options

Cumulative impacts refer to one or more individual effects which, when taken together, are considerable or which compound or increase other environmental impacts. Such effects result from the incremental impact of a project when added to other closely related past, present, and reasonably foreseeable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time.

As discussed above, Option 1 (Additional Treatment Facilities) of the No Project/Current Basin Plan Alternative would not result in any significant environmental impacts, and would be protective of Deer Creek's beneficial uses influenced by creek pH and turbidity. Moreover, it would not incrementally contribute to any known cumulative impacts to identified resources, with the exception of Delta water quality. The addition of sodium hydroxide (a salt) to the DCWWTP effluent for pH adjustment would load additional salts or total dissolved solids (TDS) to downstream water bodies and the Delta. Delta water purveyors have identified total TDS as one of their primary concerns regarding the quality of municipal and industrial water supplies diverted from the Delta. Through comments at stakeholder workshops held for the SRWTP 2020 Master Plan EIR, Delta water purveyors (e.g., California Urban Water Agencies, Contra Costa Water District, Metropolitan Water District) indicated they would consider additional loading of TDS (i.e., salts) to the system from upstream point source discharges, particularly SRWTP, as a significant impact to their raw water supplies. Although seawater intrusion is the primary factor affecting the salinity of Delta waters, runoff, treated wastewater discharges, and agricultural drain return water also can incrementally contribute to Delta TDS levels.

Although the additional loading of salts from the DCWWTP under Option 1 of the No Project/Current Basin Plan Alternative would be minor in the context of Delta TDS levels, it, nevertheless, would incrementally contribute to cumulatively significant impacts to Delta water quality. As such, it would constitute a **potentially significant cumulative impact** to Delta-diverted raw water supplies.

As discussed above, Option 2 (Effluent Reuse) of the No Project/Current Basin Plan Alternative would result in significant environmental impacts to Deer Creek aesthetics, biological resources, hydrology, recreation, and water quality of Bass Lake and Deer Creek, relative to existing conditions and conditions under the Proposed Project. As such, Option 2 could incrementally contribute to potential cumulative impacts to these same resources. Consequently, implementation of Option 2 would constitute **significant cumulative impacts** to Deer Creek aesthetics, biological resources, hydrology, and recreation. Moreover, implementation of Option 2 may constitute a **potentially significant cumulative impact** to biological resources within El Dorado and Sacramento Counties, and Deer Creek water quality (SWRCB 1995).

The significant impacts identified for Option 3 (Connect to SRWTP) of the No Project/Current Basin Plan Alternative include significant impacts to Deer Creek aesthetics, biological resources, hydrology, recreation, and water quality of Deer Creek. These impacts were primarily the result of ceasing discharge of treated effluent to Deer Creek year-round, relative to existing conditions. Option 3 could incrementally contribute to potential cumulative impacts to these same resources of Deer Creek and the region. Consequently, implementation of Option 3 would constitute **significant cumulative impacts** to Deer Creek aesthetics, biological resources, hydrology, and recreation. Moreover, its implementation would constitute a **potentially significant cumulative impact** to biological resources within El Dorado and Sacramento Counties, and Deer Creek water quality relative to existing conditions and conditions under the Proposed Project (SWRCB 1995).

9.8 RECOMMENDED ALTERNATIVE

Based on the analysis of the Proposed Project and each of the three options under the No Project/Current Basin Plan Alternative presented above, Regional Board staff recommend approval and implementation of the Proposed Project.

9.9 DE MINIMUS FINDING

The Regional Board staff, after consideration of the evidence, recommend that the Regional Board find that the proposed project has no potential for adverse effect, either individually or cumulatively on wildlife.

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APPENDIX A

RECOMMENDED FORMAT FOR COMMENT LETTERS

Comment letters to the Regional Board on staff recommendations serve two purposes: (1) to point out areas of agreement with staff recommendations; and (2) to suggest revisions to staff recommendations. Clear statements of both areas of agreement and suggested revisions will assist the Regional Board and staff in understanding the recommendations of the commenter. The California Environmental Quality Act requires staff to respond to those comments submitted by the public which suggest revisions to staff recommendations, as long as those comments concern revisions to the Basin Plan Amendment. In order to aid staff in identifying suggested revisions and to respond to the specific concerns of the commenter, the following format for comment letters is suggested.

FORMAT FOR COMMENTS SUGGESTING REVISIONS

The suggested format is to number to the comment, state in one sentence the topic upon which the comment is directed, provide a supporting argument, and make a recommendation. Supporting arguments which include citations will assist staff in considering the comment. Below is an example.

> The Environmental Action Team (EAT) recommends the following revision to staff recommendations:
>
> *1. Proposed Xenon objective for Slug Slough*
>
> Staff has recommended a 0.001 ng/L Xenon objective to protect resident guppies in slug Slough. The U.S. EPA Xenon criteria for protection of guppies in fresh waters is currently 0.0001 ng/L – an order of magnitude lower than the staff recommendation. The U.S. EPA criteria is supported by several studies in peer reviewed journals (e.g., Smith and Jones; J. Env. Qual. (1994); Johnson; J. Env. Qual. (1995)). Staff arguments that the cost of analyzing for Xenon in water below 0.001 ng/L is prohibitive does not support the adoption of a water quality that is not protective of beneficial uses. More cost effective analytical procedures may be developed in response to the need for more intensive Xenon analysis. EAT, therefore, strongly recommends the adoption of a 0.0001 ng/L Xenon objective to fully protect guppies in Slug Slough.

FORMAT FOR COMMENTS SUPPORTING STAFF RECOMMENDATIONS

If the commenter concurs with a staff recommendation, a statement to that effect will assist the Regional Board in determining what action, if any, to take on the staff recommendation. In general, no supporting discussion need be presented, unless the commenter feels that the staff recommendation could be further enhanced or clarified. Below is an example.

1. Proposed Neon objective for Slug Slough

EAT strongly supports the adoption of the 0.05 pg/L Neon objective proposed by staff for Slug Slough. In addition to arguments presented by staff, it should be pointed out that Harrison's recent work on goldfish (Harrison, et al, 1996) confirms the appropriateness of the proposed objective for the protection of fresh water aquatic life.

APPENDIX B

HISTORICAL PERSPECTIVE ON THE DEVELOPMENT OF WATER QUALITY CRITERIA

The genesis of water quality criteria in the United States began in the early 1900s, with the publication of technical documents identifying the effects of contaminants and pollution on fish. Ellis (1937) published the first “review document” describing the effects of numerous substances on aquatic life. In 1952, the State of California published a 512-page book on “water quality criteria” associated with eight beneficial uses of water. Concentration-effect levels for various contaminants were discussed for each of the designated uses. This document was edited and greatly expanded into a second edition in 1963 (McKee and Wolf 1963). This second edition marked the first comprehensive effort of bringing together, under one cover, the world’s scientific literature on water quality criteria for the protection of stated beneficial uses, including the protection of freshwater aquatic life.

In 1966, the Secretary of the Interior appointed a number of nationally recognized scientists to a National Technical Advisory Committee to develop water quality criteria for five (5) specified uses of water, including: domestic water supply, recreation, fish and wildlife, agricultural, and industrial (USEPA 1976). The report, which has become known as the “Green Book”, was published in 1968 by the Federal Water Pollution Control Administration (FWPCA 1968), and was reprinted in 1972 by the U.S. EPA. The Green Book was the first water quality criteria document that developed *recommendations*, involving professional judgment, based on the scientific literature. Its publication marked a distinct change in the development and use of water quality criteria from one of simply compiling available concentration-effect data to one that recommended specific concentrations that, when met, would ensure the protection of the quality of the environment and the continuation of the designated beneficial use (USEPA 1976).

The U.S. EPA contracted with the National Academy of Sciences and the National Academy of Engineering to expand and improve upon the concept brought forth in the Green Book, and to update the scientific basis upon which water quality criteria were based. The result of this effort was a 1973 publication that presented water quality criteria as of 1972 (USEPA 1973). This water quality criteria document has become known as the U.S. EPA’s “Blue Book.” Since publishing its Blue Book on water quality criteria in 1973, the U.S. EPA published updates to this document in 1976 (USEPA 1976), referred to as the “Red Book”, and in 1986 (USEPA 1986), referred to as the “Gold Book.”

This brief history of the development of water quality criteria in the United States is provided because technical review and discussion of these documents in this report: 1) illustrates the likely origins of the water quality objectives for pH and turbidity in the current Basin Plan; and 2) identifies the extent to which current Basin Plan objectives are consistent with past and present national criteria, and the scientific information used to develop these criteria. Understanding the technical defensibility and origin of current Basin Plan objectives based on the scientific weight-of-evidence regarding physiological requirements of freshwater aquatic life (particularly for species occurring in Deer Creek) provides an appropriate scientific and regulatory basis from which to propose site-specific water quality objectives for Deer Creek.

APPENDIX C

PH REQUIREMENTS
OF
FRESHWATER AQUATIC LIFE

The pH of surface waters is important to aquatic life because pH affects the ability of fish and other aquatic organisms to regulate basic life-sustaining processes, primarily the exchanges of respiratory gasses and salts with the water in which they live. Failure to adequately regulate these processes can result in numerous sublethal effects (e.g., diminished growth rates) and even mortality in cases when ambient pH exceeds the range physiologically tolerated by aquatic organisms.

TYPICAL AMBIENT pH IN FRESH WATERS

Based on their review of the scientific literature, McKee and Wolf (1963) stated that, of United States waters surveyed that supported "…good fish communities…", only about 5% had a pH less than 6.7; 50% had a pH less than 7.6; and in 95% the pH was less than 8.3. pH values above 8.5 are often associated with high rates of photosynthetic activity and/or underlying limestone geology. Conversely, some regions have soft water with low alkalinity and, therefore, low buffering capacity against acidification, which often results in naturally low pH (e.g., 5.5-6.5 pH units). The majority of surface water bodies in the United States have pH values of between approximately 6 and 9, with most of these having a pH between 6.5 and 8.5 (Warren 1971). Exceptions on the low end of the pH range include acidic bogs and lakes in northeastern North American that have become acidified from acid rains. Highly alkaline systems are typically the result of surrounding geology (e.g., limestone). Alkaline systems can experience further elevations in pH, particularly during the summer months, due to high rates of photosynthesis by aquatic plants.

DIRECT EFFECTS OF pH ON AQUATIC LIFE

The effects of pH on fish and other freshwater aquatic life have been reviewed in detail (e.g., Doudoroff and Katz 1950; McKee and Wolf 1963; EIFAC 1969; Katz 1969; USEPA 1973; AFS 1979; Alabaster and Lloyd 1980). The pH of water affects the normal physiological functions of aquatic organisms, including the exchange of ions with the water, and respiration. Such important physiological processes operate normally in most aquatic biota under a relatively wide pH range (e.g., 6-9 pH units). There is no definitive pH range within which all freshwater aquatic life is unharmed and outside which adverse impacts occur; rather, there is a gradual “deterioration” in acceptability as pH values become further removed from the normal range (EIFAC 1969; AFS 1979; Alabaster and Lloyd 1980). The acceptable range of pH to aquatic life, particularly fish, depends on numerous other factors, including prior pH acclimatization, water temperature, dissolved oxygen concentration, and the concentrations and ratios of various cations and anions (McKee and Wolf 1963).

Alabaster and Lloyd (1980) identified the pH range that is not directly lethal to freshwater fish as 5.0-9.0. With few exceptions, pH values between 6.5 and 9.0 are satisfactory, on a long-term basis, for fish and other freshwater aquatic life. The pH of most inland fresh waters containing fish ranges from about 6 to 9 (Ellis 1937), with most waters, particularly those with healthy, diverse, and productive fish and macroinvertebrates communities having a pH between approximately 6.5 and 8.5 units

(Ellis 1937; McKee and Wolf 1963; FWPCA 1968; USEPA 1973). In establishing water quality criteria for pH, ORVWSC (1955) stated that, although fish had been found at pH values from 4-10, the safe range was 5-9 and for maximum productivity the pH should be maintained between 6.5 and 8.5. Some aquatic organisms (e.g., certain species of algae) have been found to live at pH 2 and lower, and others at pH 10 and higher (USEPA 1973). However, there are few such organisms, and their extreme tolerances are not reflective of the pH tolerated by the majority of organisms occurring in a given aquatic ecosystem.

In response to the acid rain problems occurring in the eastern United States and Canada, the physiological effects of acid stress on fish and other aquatic life have been well documented (e.g., see Alabaster and Lloyd 1980; AFS 1982). A number of researchers have proposed that the toxic action of hydrogen ions on fish under acidic conditions involves production of mucus on the gill epithelium, which interferes with the exchange of respiratory gasses and ions across the gill; precipitation of proteins within the epithelial cells; and/or acidosis of the blood (also affecting oxygen uptake) (Ellis 1937; Westfall 1945; Leivestad, in AFS 1982; Boyd 1990). Hence, respiratory distress and osmotic imbalance are the primary physiological symptoms of acid stress in fish. Less research has been conducted on the effects of acid stress on macroinvertebrates. However, those species that exchange respiratory gasses and regulate ions through their tracheal system and gills (e.g., mayflies and stoneflies) and/or species affected by blood acid-base balance may experience effects similar to fish.

Below a pH of 5.0, mortality occurs in some life stages of certain fish species, although some fishes can be acclimated to pH levels below 4.0. Certain species of macroinvertebrates can tolerate very low pH values. Lackey (1938) found *Gammarus* spp. in two streams with pH values of 2.2 and 3.2, mosquito larvae in a stream at pH 2.4, and caddis fly larvae (*Trichoptera*) at pH 2.4. Nevertheless, the primary productivity of freshwater aquatic ecosystems is reduced considerably below pH 5.0, which, in turn, reduces the food supply for higher organisms. Hence, fish that remain present would likely experience reduced numbers and/or growth rates (Alabaster and Lloyd 1980).

The physiological effects on aquatic life induced by high pH (>9) have been studied less than those at low pH. This is likely because high pH waters are less common (Doudoroff and Katz 1950; Alabaster and Lloyd 1980). Several researchers concluded that the toxic mode of action of hydroxyl ions (i.e., high pH values) is hypertrophy of mucus cells at the base of the gill filaments and destruction of gill and skin epithelium, with effects on the eye lens and cornea (Alabaster and Lloyd 1980; Boyd 1990).

Studies have shown that pH values of between 9 and 10 can result in partial mortality for bluegill sunfish (*Lepomis macrochirus*), rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), salmon, and perch. The majority of freshwater fishes and macroinvertebrates experience harmful effects (lethal or sublethal) at one or more life stages at pH values above 10 (Weibe 1931; AFS 1979; Alabaster and Lloyd 1980). Where high pH is caused by high levels of photosynthetic activity of aquatic plants, high water temperatures and supersaturation of dissolved gasses also may occur and may contribute to physiological effects experienced by aquatic organisms, making it difficult to correlate mortality with laboratory data on pH alone. Based on their review of the literature, Alabaster and Lloyd (1980) stated that chronic exposure to pH values above 10 was harmful to all species studied, while salmonids and some other species were harmed at pH values above 9.

Based on present evidence, the U.S. EPA has concluded that a pH range of 6.5 to 9.0 provides adequate protection for the life of freshwater fish and bottom-dwelling macroinvertebrates. Outside this range, fish suffer adverse physiological effects that increase in severity as the degree of deviation increases until lethal levels are reached (USEPA 1976, 1986).

EFFECTS OF DIURNAL FLUCTUATIONS AND RAPID pH CHANGES ON AQUATIC LIFE

The pH of lakes and streams often changes during the day in response to photosynthetic activity. In ponds having poorly buffered (low alkalinity) waters, the pH may fall to 6 in the early morning and increase to 9 or more in the afternoon. Good fish production usually can be maintained despite these daily fluctuations (Boyd 1990). In most lakes and ponds, diurnal pH fluctuations during the summer, when photosynthetic activity peaks, are generally less than 2 pH units, with diurnal fluctuations in streams typically being lesser (e.g., 0.5-1.5 units). Unless diurnal fluctuations result in ambient pH falling below 6 or being elevated above 9, they generally have no adverse impact on aquatic life. This is supported by the study findings discussed below.

Fish

Although it was once believed that fish could not tolerate sudden pH changes, studies conducted by Brown and Jewell (1926) and Wiebe (1931) showed that fish species tested could tolerate such rapid changes, particularly within the normal pH range. In fact, Brown and Jewell (1926) observed catfish and perch living in a bog lake having a pH of 4.4-6.4 and in a nearby glacial lake having a pH of 8.2-8.7. These researchers demonstrated that the fish from both lakes survived transfer from one lake to another.

Wiebe (1931) reported that sunfish (*Lepomis spp.*) and goldfish (*Carassius auratus*) survived rapid changes from pH 7.2 to 9.6 (2.4 units); largemouth bass (*Micropterus salmoides*) from pH 6.1 to 9.6 (3.5 units); and smallmouth bass (*Micropterus dolomieui*) from pH 6.6 to 9.3 (2.7 units). Witschi and Ziebell (1979) transferred rainbow trout from water of pH 7.2 to waters of pH 8.5, 9.0, and 10.0. Survival after 48 hours was 100% for fish transferred to pH 7.2 and 8.5 (1.3-unit change); 88% for those transferred to pH 9.0 (1.8-unit change, with resulting pH 0.5 units above 8.5); 68% for pH 9.5 (2.3-unit change, with resulting pH 1.0 unit above 8.5); and complete mortality occurring for fish transferred to pH 10.0 (2.8-unit change, with resulting pH 1.5 units above 8.5). This study clearly demonstrated that rainbow trout could handle rapid pH changes of 1.3 units (from 7.2 to 8.5) without experiencing mortality. The mortality that occurred when transferred to pH 9.0, 9.5, and 10.0 water was more likely due to being transferred to a pH outside the acceptable range for the species than due to the pH change itself (J. Modin, Sr. Fish pathologist, Inland Fisheries Division, CDFG, pers. Comm., 1998). If no acute mortality occurs, no chronic effects would be expected because of physiological acclimation to the new pH, which occurs within a short period of time (i.e., hours to days).

The studies discussed above demonstrated that the fish species studied tolerated rapid pH changes of 1.3 to 3.5 pH units when these changes occurred within the physiologically-tolerated pH range. When the pH changed to a value that approached the species' normal upper tolerance level (e.g., 9.0) or exceeded their upper tolerance limit (e.g., 9.5 and 10.0), mortality occurred (Witschi and Ziebell 1979). Based on findings from these studies and personal communications with CDFG fish pathologists (J. Modin, Sr. Fish pathologist, Inland Fisheries Division, CDFG, pers. comm., 1998), it is concluded that neither acute mortality nor chronic sublethal effects would be expected in fish experiencing rapid pH changes when all pH levels to which fish are exposed remain within the range of 6.5 to 8.5 pH units. Conversely, studies suggest that small pH changes (e.g., 1 pH unit) could have adverse impacts when the resulting pH value falls outside the physiologically acceptable range for a given species. For example, rainbow trout acclimated to pH 9.0, which is at or near the species' upper limit, would be expected to experience high mortality if transferred to pH 10.0 and, in fact, would be expected to experience mortality if transferred to pH 9.5 – a change of just 0.5 units.

The ability of fish to rapidly acclimate to waters having substantially different pH values is further demonstrated by hatchery stocking programs and the freshwater tropical fish (aquarium) industry, where it is common to move fish from one water body or aquarium to another that differ by more than 0.5 pH units. However, it should be noted that this "stocking" of fish typically involves waters with pH values in the range of 6.5 to 8.5 units so that the fish are transferred to waters with pH values well within the range that is physiologically acceptable to them. Data available regarding pH values tolerated by macroinvertebrates suggest that, like fish, they can rapidly adapt to changes in ambient pH levels within their natural pH range (Alabaster and Lloyd 1980; Boyd 1990).

Benthic Macroinvertebrates

A technical review of the effects of rapid pH changes on benthic macroinvertebrates revealed several lines of evidence indicating that macroinvertebrates rapidly exposed to pH changes of one unit or more, when pH is maintained within the 6.5 to 8.5 range, would not experience mortality, or other long-term adverse effects. Information supporting this finding is discussed further below. To increase the utility of this technical information, findings are related to the pH gradient that occurs within the mixing zone associated with the DCWWTP discharge into Deer Creek. Benthic macroinvertebrates could experience rapid pH changes in this mixing zone when moving through the zone as part of the "drift" phenomenon. Drift is a term used to describe the act of macroinvertebrates releasing themselves from the substrate, floating downstream with the current, and ultimately reattaching to the streambed somewhere downstream.

The available scientific literature on the effects of rapid pH reductions on benthic macroinvertebrates provides the first line of evidence to suggest that rapid pH reductions of one unit or more, when pH is maintained between 6.5 and 8.5, would not cause chronic, adverse effect on individual macroinvertebrates or their populations. A thorough review of the scientific literature was conducted to identify studies that investigated the effects of rapid pH changes on macroinvertebrates, when pH was maintained between 6.5 and 8.5. No such studies were found. However, numerous studies documenting effects on benthic macroinvertebrates when pH was lowered from an ambient pH level within the 6.5-8.5 range to an acidified condition, with ending pH typically at or below 6.0 pH units. The fact that no studies could be found in the scientific literature that documented adverse effects of pH change(s), when ending pH was maintained within the 6.5-8.5 range suggests that rapid pH changes within the 6.5 to 8.5 range are not problematic to benthic macroinvertebrates. Based on the commonality of their experimental approaches, the acidification studies that are available in the scientific literature suggest that significant adverse effects to individual macroinvertebrates and their communities would not be expected to occur upon experiencing a rapid pH reduction unless the ending pH is below about 6.0. Several studies that investigated the effects of stream acidification on benthic macroinvertebrate communities, where ending pH was below 6.0, provide information that sheds additional light on how the pH gradient within the mixing zone at Deer Creek would affect benthic macroinvertebrates drifting through this zone; hence, findings from these studies are briefly summarized below.

Bernard et al. (1990) acidified experimental reaches of a British Columbia stream from pH 7.0 to 5.9 within 30 minutes to assess the effect of mild acidification on short-term invertebrate drift. They reported that small Ephemeroptera showed no initial response to pH reductions from 7.0 to 5.9, but that their drift increased after about 6 hours. Increased drift was observed for Chironomid and Trichoptera within an hour of reaching pH 5.9. Harpactacoid copepods, Hydrcarina, simulid Diptera, Plecoptera, and large Ephemeroptera did not respond. Lack of a drift response induced by rapid pH reduction in certain taxa demonstrates that the organisms were not adversely affected enough to move, and consequently, would not be affected enough to experience mortality. Kratz et al. (1994) reported that Simuliids (black flies) did not respond to rapid depressions of 1 pH unit below ambient, with the ending pH being below 6.0. Also, Hall et al. (1987) reported no effect on daytime drift rates in acidic Norris Brook, where pH was reduced from 6.4 to 5.2-5.5. Bernard et al. (1990) surmised that the rapid, large increases in drift exhibited by chironomids was avoidance behavior. Sensitive organisms may escape by drift to more suitable conditions downstream. Bernard (1985) (cited in Bernard et al. 1990) supported this hypothesis by showing that rapidly responding mayflies collected in a stream rapidly acidified to pH 5.7 had greater than 95% survival when subsequently held in circumneutral water (i.e., water having pH near 7.0) for 24 hours. Kratz et al. (1994) concurred with these findings, suggesting that mild pH reductions (i.e., those with an ending pH near 6.0 or above) would likely elicit increased drift in some species due to behavioral responses rather than from causing pH-related mortality, whereas mortality-induced drift would increase as ending pH decreases, and reached lethal levels (e.g., 5.5 or lower).

To determine the direct effects of water chemistry on invertebrates sensitive to pH reductions, Rosemond et al. (1992) transplanted three mayfly species (i.e., *Drunella conestee (*Family Ephemerellidae) and *Stenonema* sp. and *Epeorus pleuralis* (Family Heptageniidae)) from a stream having pH of 6.6-6.8 to: 1) the stream from which they were collected (i.e., back into pH 6.6-6.8), and 2) a stream of pH 5.0 (a rapid pH change of 1.6-1.8 units). In the first *in situ* transplant experiment, there was no significant difference in mortality among the individuals of *Drunella conestee* transplanted into the two sites through 9 days post transplant. Mortality rates were 32% for organisms transplanted back into the same pH, and 28% for those transplanted into pH 5.0. In the second *in situ* experiment, using *Stenonema* sp., and *Epeorus pleuralis*, both species transplanted into the pH 5.0 stream experienced significantly higher mortality that those transplanted back into the original stream. In addition, the ultimate mortality experienced by these two species transplanted into the 5.0 pH stream differed significantly. These researchers concluded that the different sensitivities of the three species was due to differences in sensitivities to *ending pH* and acquired body burdens of aluminum, rather than to the initially-experienced rapid change in pH. This was supported by the fact that it took 2-6 days for mortality rates to differ between transplant groups for the same species. An inability to tolerate the initial pH shock (an acute phenomenon) would be expected to become apparent within a matter of hours rather than days.

The above information is of particular relevance because macroinvertebrates drifting through the mixing zone at Deer Creek would typically pass through the zone in a matter of minutes to hours. Second, maximum pH changes, due to effluent discharges, occur during the summer period of the year. During the summer months, high rates of photosynthesis cause creek pH, upstream of the discharge, to approach and occassionally exceed 8.5 units. Effluent discharges under such conditions can cause 1-1.5 unit reductions in pH, with an ending pH at the downstream end of the mixing zone typically being 7.0 to 7.5 pH units. Third, field investigations in Deer Creek have documented that, under such conditions, photosynthetic activity within the creek causes creek pH to again approach and even exceed 8.5 within the first 0.5 miles downstream of the discharge. Finally, effects of effluent discharges on creek pH are lesser during the fall, winter, and spring periods of the year, relative to that observed during the summer months. In all cases, effluent discharges never cause creek pH to go outside the 6.5 to 8.5 range. Conversely, sometimes effluent discharges reduce creek pH that is above 8.5, thereby bringing it back within the 6.5 to 8.5 target range defined in the current Basin Plan objective, which is maintained under the proposed amendment.

Bell and Nebeker (1969) investigated the tolerance of aquatic insects to low pH. In this study, caddisfly, stonefly, dragonfly, and mayfly nymphs were exposed to a range of pH levels for 96 hours (4 days) to determine the pH levels at which 50% of the test organisms died (96-hr TL_{50}). Field-collected nymphs were acclimated to the laboratory for one week at pH 7.8. However, no gradual acclimation to test pH levels was reported. In fact the methods stated: "*If the test pH deviated by more than 0.25 pH units from the desired pH, the test was terminated*." Hence, test organisms were taken directly from their laboratory acclimation tank (pH 7.8), and placed directly into test tanks maintained at pH 1.0-7.0. The 96-hr TL_{50} values reported for the 10 species tested (from the families identified above) ranged from a low of 1.5 (the caddisfly *Brachycentrus americanus*) to a high of 4.65 (the mayfly *Ephemerella subvaria*) pH units. All 10 species tested showed 100% survival at pH 6.0, a 1.8 unit change from their acclimated pH of 7.8. The mayfly *Ephemerella subvaria* began to experience some mortality at test pH levels below 6.0. However, the caddisfly *Hydropsyche betteni*, stonefly *Acroneuria lycorias*, dragonfly *Boyeria vinosa*, and mayfly *Stenonema rubrum* all showed 100% survival at test pH levels as low as 5.5. Hence, these species showed no mortality when transferred from the acclimation tank at pH 7.8 to test tanks at pH 5.5, thereby experiencing a rapid pH change of 2.3 pH units. The caddisfly *Brachycentrus americanus* showed 100% survival to pH levels of 4.5, thereby experiencing a rapid pH change of 3.3 pH units.

In a follow-up study, Bell (1970) performed similar experiments with the same species of benthic macroinvertebrates, but extended the test period from 96 hours to 30 days. Findings were similar to the 96-hr study, except that the 30-day TL_{50}s were somewhat higher (i.e., higher pH levels) than those reported for the 96-exposure.

Findings from these studies concur with those of the studies discussed above, indicating that the ending pH is more important in determining mortality than the magnitude and rate of initial pH change. Moreover, neither the Bell studies nor any of the other studies discussed above for either fish or benthic macroinvertebrates documented pH-caused mortality when ending pH was within the 6.5 to 8.5 range. In fact, these studies showed that rapid pH reductions of up to 1.6 pH units, with an ending pH below 6.0, did not cause elevated mortality in mayflies, a taxa of benthic macroinvertebrates shown through numerous studies (e.g., Kratz et al. 1994; Feldman and Connor 1992; Rosemond et al. 1992) to be the most sensitive taxa to pH reductions. Mortality was not shown to occur in sensitive mayfly species, or other macroinvertebrate taxa, when the ending pH was maintained at or above 6.5, as would always occur in Deer Creek under the proposed pH objective.

Personal communications with several macroinvertebrate experts provide a second line of evidence in support of the conclusions pertaining to rapid pH changes stated above. S. Cooper (U.C. Santa Barbara, pers. comm., 1999), R. Haro (U.W. LaCrosse, pers. comm., 1999), and J. Harrington (CDFG, pers. comm., 1999) all concurred that the lack of studies in the scientific literature addressing pH changes within the 6.5 to 8.5 range suggest that rapid changes within this range are unlikely to adversely affect macroinvertebrates. Moreover, none of these experts were aware of any studies reported in the literature that document mortality to macroinvertebrates resulting from rapid pH changes with in the 6.5 to 8.5 range.

When asked to give their professional opinion regarding potential effects of rapid pH changes on benthic macroinvertebrates within the context of what can occur across the mixing zone at Deer Creek, the following statements were made.

A pH change from 8.5 to 7.0, for example, would not be expected to have a lethal effect, but could have a sublethal (e.g., behavioral) effect. Nevertheless, sublethal effects would be expected to cease when the macroinvertebrates acclimated to the new pH. One would not expect to see lethal effects until the ending pH fell outside the normal pH range, perhaps 5.5 or 5.0 pH units (S. Cooper, U.C. Santa Barbra, pers. comm., 1999). S. Cooper is considered to be the leading expert on the West Coast regarding the effects of acid pulses on stream benthic macroinvertebrates.

As long as pH remained within the 6.5 to 8.5 range (referred to as circumneutral), there generally would not be any substantial adverse effects to macroinvertebrates drifting downstream into the effluent-dominated portion of the creek, where pH could be 1-2 units lower. Short-term, sublethal (e.g., behavioral) effects could occur in some species (R. Haro, U.W. La Crosse, pers. comm., 1999).

In discussions with Jim Harrington of CDFG, regarding ranges of pH acceptable to aquatic life, he stated the following, *"The pH range of 6.5 to 8.5 is accepted to represent safe levels, and this is probably why there is not much literature on its effects to the aquatic system. When I write biological significance reports on pH-related spill events, I would conclude that there would be no deleterious effects within this range. I can also say that based on our rapid bioassessment work on Deer Creek* [CDFG 1998]*, that the benthic macroinvertebrate community does not indicate that there is a problem with pH"* (J. Harrington, CDFG, pers. comm., 1999).

Finally, the U.S. EPA's past and current national pH criteria for the protection of freshwater aquatic life provide a third line of evidence to suggest that rapid pH changes, when pH is maintained within the 6.5 to 8.5 range, would not cause adverse impacts to benthic macroinvertebrates or their communities. The U.S. EPA's 1972 pH criteria (USEPA 1973) stated the following recommendations for pH:

> *"Suggested maximum and minimum levels of protection for aquatic life are given in the following recommendations. A single range of values could not apply to all kinds of fish, nor could it cover the different degrees of graded effects. The selection of the level of protection[2] is a socioeconomic decision, not a biological one.*
>
> *Nearly Maximum Level of Protection*
> - *pH not less than 6.5 nor more than 8.5. No change greater than 0.5 units above the <u>estimated natural seasonal maximum</u>, nor below the <u>estimated natural seasonal minimum</u> [emphasis added].*
>
> *High Level of Protection*
> - *pH not less than 6.0 nor more than 9.0. No change greater than 0.5 units outside the estimated natural seasonal maximum and minimum.*
>
> *Moderate level of Protection*
> - *pH not less than 6.0 nor more than 9.0. No change greater than 1.0 units outside the estimated natural seasonal maximum and minimum.*
>
> *Low Level of Protection*
> - *pH not less than 5.5 nor more than 9.5. No change greater than 1.5 units outside the estimated natural seasonal maximum and minimum.*

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[2] <u>Nearly Maximum</u>: For virtually unimpared productivity and unchanged quality of a fishery.
<u>High</u>: Not likely to cause appreciable change in the ecosystem, nor material reduction of fish production. Some impairment is risked, but appreciable damage is not to be expected at these levels.
<u>Moderate</u>: Fisheries should persist, usually with no serious impairment, but with some decrease in production.
<u>Low</u>: Should permit the persistence of sizable populations of tolerant species. Much reduced production or elimination of sensitive fish is likely.

Additional Requirements for All Levels of Protection

- *If a natural pH is outside the stated range of pH for a given level of protection, no further change is desirable.*
- *The extreme range of pH fluctuation in any location should not be greater than 2.0 units. If natural fluctuation exceeds this, pH should not be altered.*
- *The natural daily and seasonal patterns of pH variation should be maintained, although the absolute values may be altered within the limits specified.*
- *The total alkalinity of water is not to be decreased more than 25 percent below the natural level."*

Based on the above language, used by the U.S. EPA in its 1972 pH criteria recommendations, it is clear that the 0.5 unit of change allowed under the "nearly maximum level of protection" was defined to limit the *ambient pH range*, not the magnitude of rapid change within this range. In fact, no quantitative criterion was assigned to limit rapid pH changes in freshwaters, within the preferred pH range of 6.5 to 8.5. Similarly, the U.S. EPA's current pH criterion for the protection of freshwater aquatic life (USEPA 1986; 1999) (see Section 4.1.2.2) simply defines an acceptable ambient pH range (i.e., 6.5-9.0), but does not quantitatively limit the magnitude of rapid change that freshwater organisms can be exposed to within this range (e.g., during movement through mixing zones associated with point-source discharges). Because the magnitude of rapid change to which freshwater aquatic life are exposed, within acceptable ambient pH ranges, has never been regulated as part of any national pH criterion, it can be reasonably concluded that all available scientific data on this issue indicate that the effects of rapid pH changes on freshwater aquatic life are insignificant when pH is maintained within the acceptable range (e.g., 6.5-8.5).

INFLUENCE OF PH ON AMMONIA TOXICITY

The pH of a water body also is indirectly important to aquatic life if ammonia is present in the water, such as occurs in culture ponds, hatchery raceways, or below wastewater treatment plant outfalls because the relative amounts of ammonium ions (NH_4^+) and aqueous ammonia (NH_3) are pH dependant. Aqueous ammonia is much more toxic to fish and other aquatic life than is ammonium. The fraction of total ammonia in the NH_3 toxic form increases with water temperature and pH increase. For example, at 26^{o}C, the U.S. EPA's chronic ammonia criterion for the protection of freshwater aquatic life (fish early life stages present) identifies an acceptable total ammonia concentration of 2.82 mg/l at pH 7.0, but 1.16 mg/l at pH 8.0 and only 0.23 mg/l at pH 9.0 (USEPA 1999). This is because at 26^{o}C, the fraction present as NH_3 is approximately 0.6% at pH 7.0, 5.7% at pH 8.0, and approximately 38% at pH 9.0. Hence, all other factors remaining constant, more than a 10-fold reduction in total ammonia concentration must occur at pH 9, relative to total ammonia concentrations at pH 7, in order to provide similar levels of protection against ammonia toxicity to aquatic life. Consequently, waters involving intensive fish culture, where ammonia levels can become elevated, or water bodies receiving effluent containing ammonia pose the greatest risk to aquatic life from ammonia toxicity when pH is high (e.g., 8-9), and would pose significantly lower risks if pH were maintained at lower levels (e.g., near 7).

PERCENTAGE UN-IONIZED AMMONIA IN AQUEOUS SOLUTION AT DIFFERENT pH VALUES AND TEMPERATURES

pH	Temperature (°C)								
	16	18	20	22	24	26	28	30	32
7.0	0.30	0.34	0.40	0.46	0.52	0.60	0.70	0.81	0.95
7.2	0.47	0.54	0.63	0.72	0.82	0.95	1.10	1.27	1.50
7.4	0.74	0.86	0.99	1.14	1.30	1.50	1.73	2.00	2.36
7.6	1.17	1.35	1.56	1.79	2.05	2.35	2.72	3.13	3.69
7.8	1.84	2.12	2.45	2.80	3.21	3.68	4.24	4.88	5.72
8.0	2.88	3.32	3.83	4.37	4.99	5.71	6.55	7.52	8.77
8.2	4.49	5.16	5.94	6.76	7.68	8.75	10.00	11.41	13.22
8.4	6.93	7.94	9.09	10.30	11.65	13.20	14.98	16.96	19.46
8.6	10.56	12.03	13.68	15.40	17.28	19.42	21.83	24.45	27.68
8.8	15.76	17.82	20.08	22.38	24.88	27.64	30.68	33.90	37.76
9.0	22.87	25.57	28.47	31.37	34.42	37.71	41.23	44.84	49.02
9.2	31.97	35.25	38.69	42.01	45.41	48.96	52.65	56.30	60.38
9.4	42.68	46.32	50.00	53.45	56.86	60.33	63.79	67.12	70.72
9.6	54.14	57.77	61.31	64.54	67.63	70.67	73.63	76.39	79.29
9.8	65.17	68.43	71.53	74.25	76.81	79.25	81.57	83.68	85.85
10.0	74.78	77.46	79.92	82.05	84.00	85.82	87.52	89.05	90.58
10.2	82.45	84.48	86.32	87.87	89.27	90.56	91.75	92.80	93.84

Source: Boyd (1990).

APPENDIX D

CHARACTERIZATION OF SEASONAL pH LEVELS OF DEER CREEK AND THE DCWWTP EFFLUENT

Deer Creek Upstream of the DCWWTP

Deer Creek pH data collected immediately upstream of the DCWWTP (R1) are available from weekly *in situ* self-monitoring measurements taken by the District. Throughout most of the historic monitoring period, for which data are summarized in **Table D-1,** the R1 monitoring station was located approximately 0.25 miles downstream of the road bridge crossing the main channel of Deer Creek at the entrance to the DCWWTP. This location was approximately 100 ft upstream of the point of initial effluent mixing with receiving water under low-flow conditions. In September 1997, when the plant's NPDES permit was renewed by the Regional Board, the R1 (upstream) water quality monitoring station was moved upstream to the road bridge crossing the creek's main channel to coincide with a new stream-flow gage installed at this location. Summary statistics of Deer Creek pH data collected at the R1 monitoring station for the period October 1, 1992 through September 30, 2001 are provided in Table D-1. The probabilities with which specified pH levels were exceeded at R1 during this period, based on these weekly *in situ* data, are presented in **Figure D-1**.

Table D-1. Summary statistics characterizing historic Deer Creek pH at the R1 (upstream) station, compiled from weekly *in situ* measurements made by the District for inclusion in Discharge Monitoring Reports, for the period October 1, 1992 through September 30, 2001.

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
N[a]	35	27	31	30	29	32	31	29	30	25	33	32
Mean	8.2	8.2	8.4	8.3	8.3	8.3	8.2	8.3	8.3	8.2	8.2	8.2
Median	8.2	8.2	8.4	8.3	8.3	8.4	8.3	8.3	8.3	8.2	8.3	8.3
SD[b]	0.2	0.2	0.2	0.3	0.2	0.2	0.3	0.1	0.1	0.3	0.2	0.2
High	8.5	8.7	8.9	8.6	8.7	8.6	8.8	8.5	8.7	8.5	8.5	8.4
Low	7.5	7.7	8.0	7.5	7.6	7.7	7.6	8.1	8.0	7.1	7.5	7.6

[a] Number of measurements in the data set for the month.
[b] Standard deviation of the mean.

Based on the weekly *in situ* measurements made by the District for the period October 1, 1992 through September 30, 2001, the natural range of pH in Deer Creek, at the R1 (upstream) monitoring station is shown to be 7.1 to 8.9, with monthly mean pH ranging from 8.2 to 8.4. The relatively high pH of Deer Creek, compared to other water bodies within the Basin, is caused by underlying limestone geology within the watershed, and photosynthetic activity of creek algal and macrophyte populations, particularly during the summer period.

Hourly monitoring data collected by the District for the period September 9, 1997 through May 26, 1998 also were compiled for the initial draft of this report. Summary statistics calculated from the hourly pH data compiled, for this period, are presented in **Table D-2**.

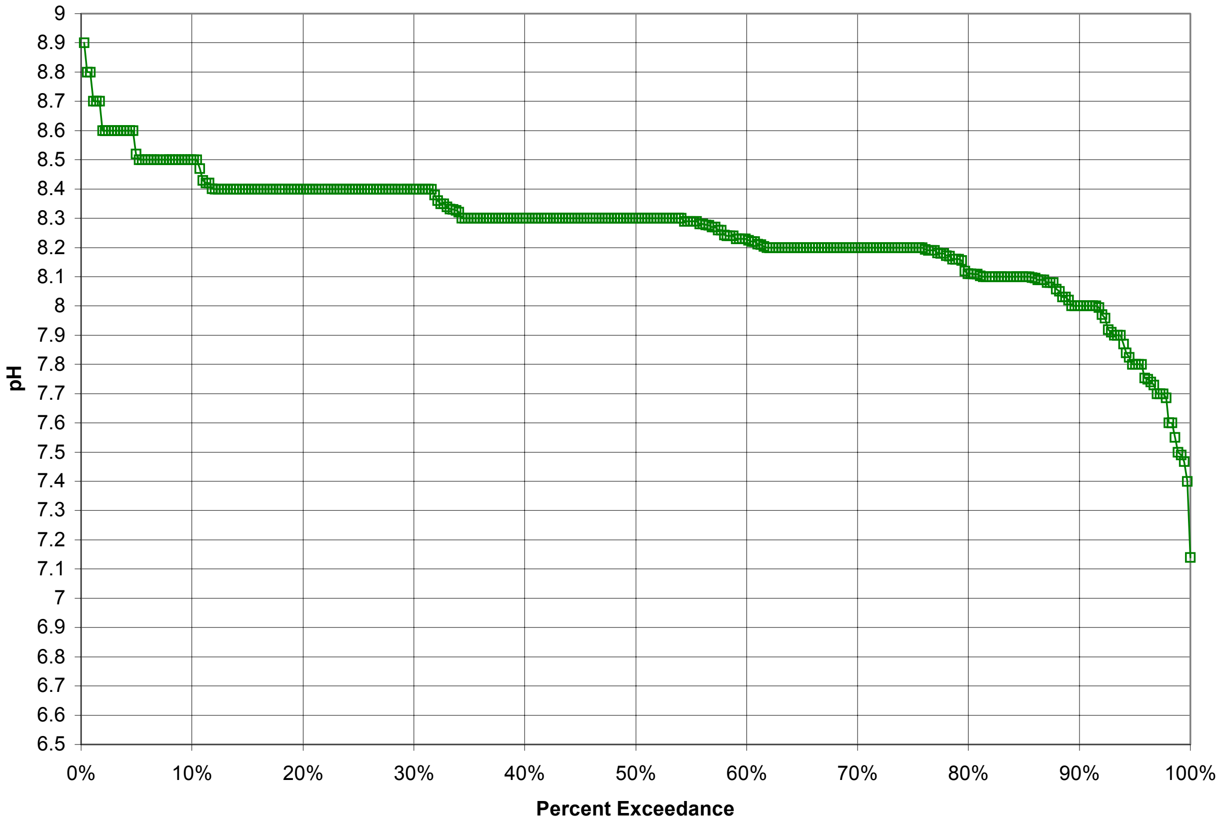


Figure D-1. Probability with which Deer Creek pH at the R1 (upstream) station exceeded specified pH values during the period October 1, 1992 through September 30, 2001. Plot is based on weekly *in situ* measurements made by the District.

Table D-2. Summary statistics characterizing Deer Creek pH at the R1 (upstream) station, based on hourly measurements compiled from a continuous monitoring data set collected by the District during the period September 9, 1997 through May 26, 1998.

Parameter	Sep 97	Oct 97	Nov 97	Dec 97	Jan 98	Feb 98	Mar 98	Apr 98	May 98
N[a]	483	791	719	694	704	626	663	606	605
Mean	8.2	8.1	8.1	8.1	7.8	7.7	8.1	8.1	8.2
Median	8.2	8.1	8.2	8.2	8.0	7.6	8.2	8.2	8.2
SD[b]	0.1	0.3	0.3	0.3	0.4	0.3	0.4	0.3	0.2
High	8.5	8.8	8.6	8.5	8.4	8.3	8.6	8.6	8.6
Low	8.0	7.3	7.1	7.0	6.6	6.9	7.3	7.4	7.9

[a] Number of measurements in the data set for the month.
[b] Standard deviation of the mean.

The hourly data set is included simply to show that creek pH at the R1 (upstream) monitoring station is more variable than depicted by the long-term, weekly *in situ* data set summarized in Table D-1. For example, the hourly data summarized in Table D-2 document the natural range of pH in Deer Creek at the R1 station to range from a low of 6.6 to a high of 8.8, with monthly mean pH values ranging from 7.7 to 8.2. Although representing only 9 of 12 consecutive months, this hourly data set (along with the weekly *in situ* data compiled in Table D-1 and the District's self-monitoring reports that are submitted to the Regional Board monthly) show that instantaneous and monthly average creek pH, at the R1 (upstream) station, are lowest in winter, increase through the spring, reaching their seasonal highs in summer, and decline again in the fall.

Overall, the Creek at the R1 station typically remains within the 6.5 to 8.5 pH range, but occasionally exceeds 8.5, particularly during the spring, summer, and fall months of the year. The hourly data set summarized in Table D-2 was not updated for this draft of the Staff Report. This is because Table D-2 (initially prepared for an earlier draft of this Report) adequately demonstrate the points stated above and, together with the weekly *in situ* data summarized in Table D-1, adequately characterize Deer Creek's seasonal pH regime at the R1 (upstream) monitoring station.

DCWWTP EFFLUENT

The District significantly upgraded the DCWWTP facilities and operations in recent years, with the majority of upgrades key to determining effluent quality being completed in late March 1997. Hence, all data discussed in this subsection were collected beginning April 1, 1997 to accurately characterize post-upgrade effluent quality. Summary statistics of daily effluent pH data for the period April 1, 1997 through September 30, 2001 are provided in **Table D-3**. The probabilities with which daily effluent pH levels exceeded specified levels during this period are presented in **Figure D-2**.

Table D-3. Summary statistics characterizing effluent pH, based on daily pH data collected by the District for inclusion in Discharge Monitoring Reports, during the post-upgrade period of April 1, 1997 through September 30, 2001.

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
N[a]	124	113	123	150	155	150	155	155	150	93	120	124
Mean	7.2	7.2	7.2	7.1	7.1	7.1	7.1	7.2	7.1	7.1	7.2	7.2
Median	7.2	7.2	7.2	7.1	7.1	7.1	7.1	7.2	7.2	7.1	7.2	7.2
SD[b]	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1
High	7.6	7.6	7.5	7.8	7.4	7.5	7.4	7.5	7.6	7.6	7.6	7.5
Low	6.8	6.9	6.9	6.7	6.7	6.8	6.8	6.8	6.7	6.8	6.7	6.9

[a] Number of measurements in the data set for the month.
[b] Standard deviation of the mean.

Based on the daily effluent measurements reported by the District for the period April 1, 1997 through September 30, 2001, the range of effluent pH is shown to be 6.7 to 7.8, with monthly mean pH ranging from 7.1 to 7.2.

In addition to the daily effluent pH data compiled for the period April 1, 1997 through September 30, 2001 (Table D-3), hourly effluent pH data collected by the District for the period September 9, 1997 through May 15, 1998 also were compiled for an earlier draft of this report. Summary statistics calculated from the hourly effluent pH data, for this period, are presented in **Table D-4**.

Table D-4. Summary statistics characterizing effluent pH, based on hourly measurements compiled from a continuous monitoring data set collected by the District, during the period September 9, 1997 through May 15, 1998.

Parameter	Sep 97	Oct 97	Nov 97	Dec 97	Jan 98	Feb 98	Mar 98	Apr 98	May 98
N[a]	528	736	716	741	689	626	666	608	350
Mean	7.0	7.1	7.2	7.2	7.1	7.2	7.1	7.1	7.0
Median	7.0	7.1	7.2	7.1	7.1	7.2	7.1	7.0	6.9
SD[b]	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.1
High	7.5	7.7	7.6	7.8	7.8	8.1	7.6	7.4	7.4
Low	6.7	6.7	6.8	6.8	6.9	6.9	7.0	6.7	6.8

[a] Number of measurements in the data set for the month.
[b] Standard deviation of the mean.

Similar to that discussed above for the R1 (upstream) monitoring station, the hourly data set does a better job of capturing the instantaneous high and low pH values that occur over time, thereby providing a more accurate estimate of the seasonal pH range and thus is included in this draft for this reason. Based on the hourly data presented in Table D-4, effluent discharged from the DCWWTP has a pH that ranges from a low of approximately 6.7 to a high of 8.1, with monthly mean pH values ranging from about 7.0 to 7.2.

Overall, available data indicate that effluent pH always remains within the 6.5 to 8.5 pH range. The hourly effluent pH data set was not updated for this draft of the Staff Report. This is because Table D-4 (initially prepared for an earlier draft of this Report) adequately demonstrate the points stated above and, together with the daily effluent pH data summarized in Table D-3, adequately characterize the seasonal pH levels of treated effluent discharged from the DCWWTP.

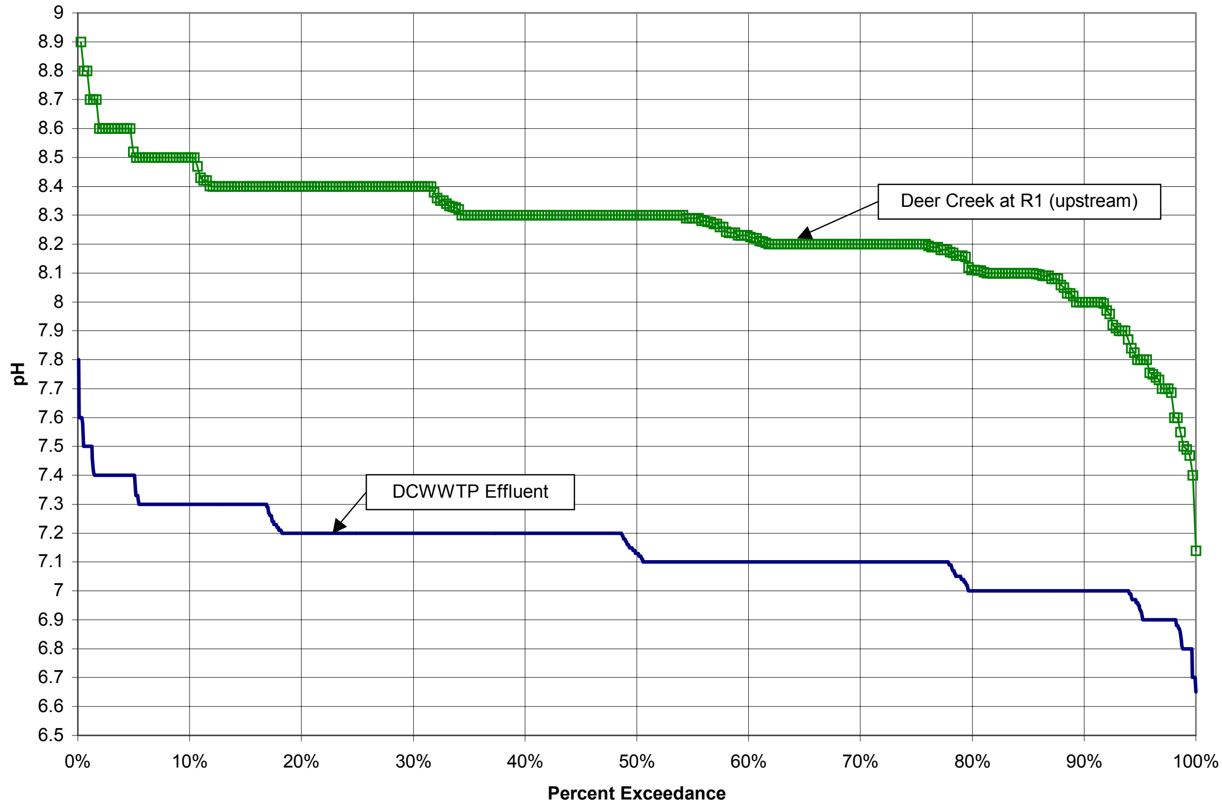


Figure D-2. Probability with which Deer Creek Wastewater Treatment Plant effluent pH exceeded specified pH values during the period April 1, 1997 through September 30, 2001. Effluent plot is based on daily pH measurements made by the District. Data for the R1 (upstream) site also are plotted for comparison purposes.

DEER CREEK DOWNSTREAM OF THE DCWWTP

All data compiled and discussed in this subsection were collected after April 1, 1997 to accurately characterize post-upgrade effluent quality. Weekly *in situ* pH measurements made by District staff at the R2 (downstream) monitoring station for the period April 1, 1997 through September 30, 2001 are summarized in **Table D-5**. The probabilities with which pH levels at the R2 (downstream) station exceeded specified levels, based on this same weekly *in situ* data set, are presented in **Figure D-3**.

Based on the weekly *in situ* R2 measurements reported by the District for the period April 1, 1997 through September 30, 2001, the range of R2 pH is shown to be 7.1 to 8.9, with monthly mean pH ranging from 7.8 to 8.0.

No hourly data are available for the R2 (downstream) monitoring station.

Table D-5. Summary statistics characterizing Deer Creek pH at the R2 (downstream) station, compiled from weekly *in situ* measurements made by the District for inclusion in Discharge Monitoring Reports, for the period April 1, 1997 through September 30, 2001.

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
N[a]	17	13	18	21	24	25	22	18	22	13	16	18
Mean	7.9	7.9	8.0	7.9	8.0	8.0	7.8	7.8	7.9	7.8	7.9	7.9
Median	7.9	8.0	8.1	7.9	8.0	8.0	7.8	7.8	7.8	7.8	8.0	7.9
SD[b]	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.3	0.2	0.2	0.2
High	8.2	8.3	8.4	8.3	8.4	8.4	8.3	8.2	8.9	8.1	8.2	8.1
Low	7.5	7.5	7.3	7.1	7.4	7.3	7.2	7.5	7.3	7.6	7.5	7.5

[a] Number of measurements in the data set for the month.
[b] Standard deviation of the mean.

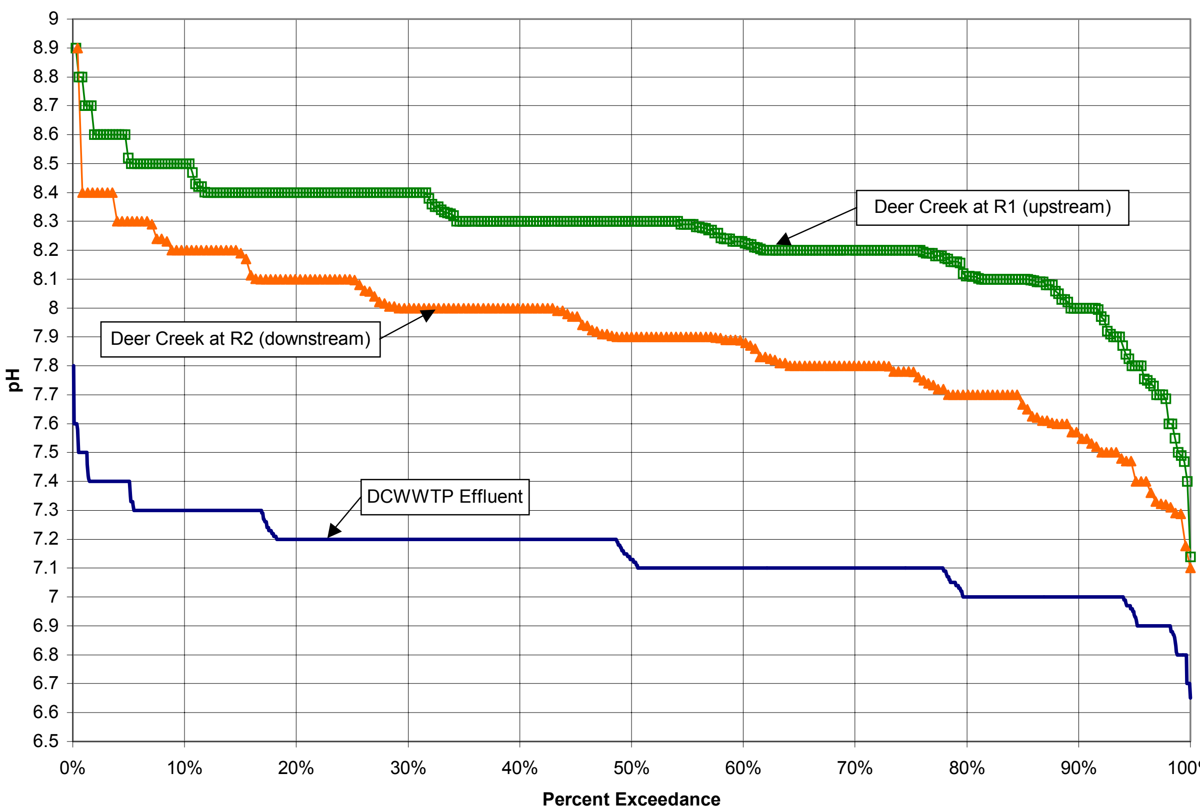


Figure D-3. Probability with which Deer Creek pH at the R2 (downstream) station exceeded specified values during the period April 1, 1997 through September 30, 2001. R2 plot is based on weekly *in situ* pH measurements made by the District. Data for the R1 (upstream) station and the effluent also are plotted for comparison purposes.

The data presented and discussed above show that the overall range of pH experienced at the R1 (upstream) and R2 (downstream) stations in Deer Creek are essentially equivalent. The primary difference regarding pH at these sites is not associated with pH range, but rather the frequency with which any particular pH occurs within the range that occurs at both sites. At both R1 and R2 locations, pH is typically within the 6.5 to 8.5 range. Creek pH is within the 6.5 to 8.5 range more often at the R2 station compared to the R1 station, because pH at the R1 station is more often above 8.5. As demonstrated by the data presented above, the R2 pH values are generally equivalent to or lower than the R1 pH values. Thus, effluent discharges tend to minimize the occasions when R2 pH would exceed 8.5 units, the upper limit specified by the current Basin Plan objective, and the upper end maintained under the site-specific pH objective proposed herein.

DIURNAL pH FLUCTUATIONS IN DEER CREEK UPSTREAM OF THE DCWWTP

To determine the extent of diurnal variation in Deer Creek pH upstream of the DCWWTP, pH at the R1 (upstream) water quality monitoring station was monitored *in situ* at 4-hour intervals for a 24-hour period, by SWRI and District staff, beginning at 8:00 am on 21 July, 1997. Creek pH was measured *in situ* using an Orion® model 250 pH meter calibrated prior to taking the first measurement and again between the 4:00 pm and 8:00 pm measurements. A diurnal pH change of 0.4 units (7.9 to 8.3 units) was found at Station R1 (current) and 0.5 units (8.0 to 8.5 units) at Station R1 (old), located approximately 400 meters downstream from the current R1 station, but upstream of the point of initial mixing with DCWWTP effluent.

During the periods October 14-18, 1994 and again from September 1-5, 1995, the CDFG conducted continuous, *in situ* pH monitoring in Deer Creek at the old Station R1 The October, 1994 data showed a diurnal variation between approximately 8.4 and 8.7 units, a change of about 0.3 units.

Similarly, evaluation of the September 1995 data indicated a pH variation from 8.3 units in the morning to 8.9 in the late afternoon (a diurnal change of about 0.6 pH units). The smaller diurnal pH change in October compared to that observed in September, 1995 and July, 1997 is likely due to differences in seasonal rates of photosynthetic activity by the algae within the creek. The higher rates of photosynthesis that occur during the warm months of July and September cause greater diurnal changes in pH compared to that observed during the shorter, cooler days of October.

pH CHANGES IN THE MIXING ZONE

Weekly pH values measured at the R1 (upstream) station were compared to the corresponding weekly pH values measured at the R2 (downstream) station. The difference in pH changes between the R1 and R2 stations were then used to develop an exceedance probability plot (**Figure D-4**). This plot shows the probability with which the pH change between the R1 and R2 stations exceeded specified magnitudes during the assessment period of April 1, 1997 through September 30, 2001.

The data show that effluent discharges increased R2 pH, relative to R1 pH, only about 5% of the time. The remainder of the time, effluent discharges decreased creek pH downstream of the mixing zone. Effluent discharges decreased creek pH by 0 to 0.5 pH units about 75% of the time, with decreases in pH ranging from about 0.6 to 1.2 units occurring approximately 18% of the time. About 2% of the time, effluent discharges had no affect on creek pH (Figure D-4).

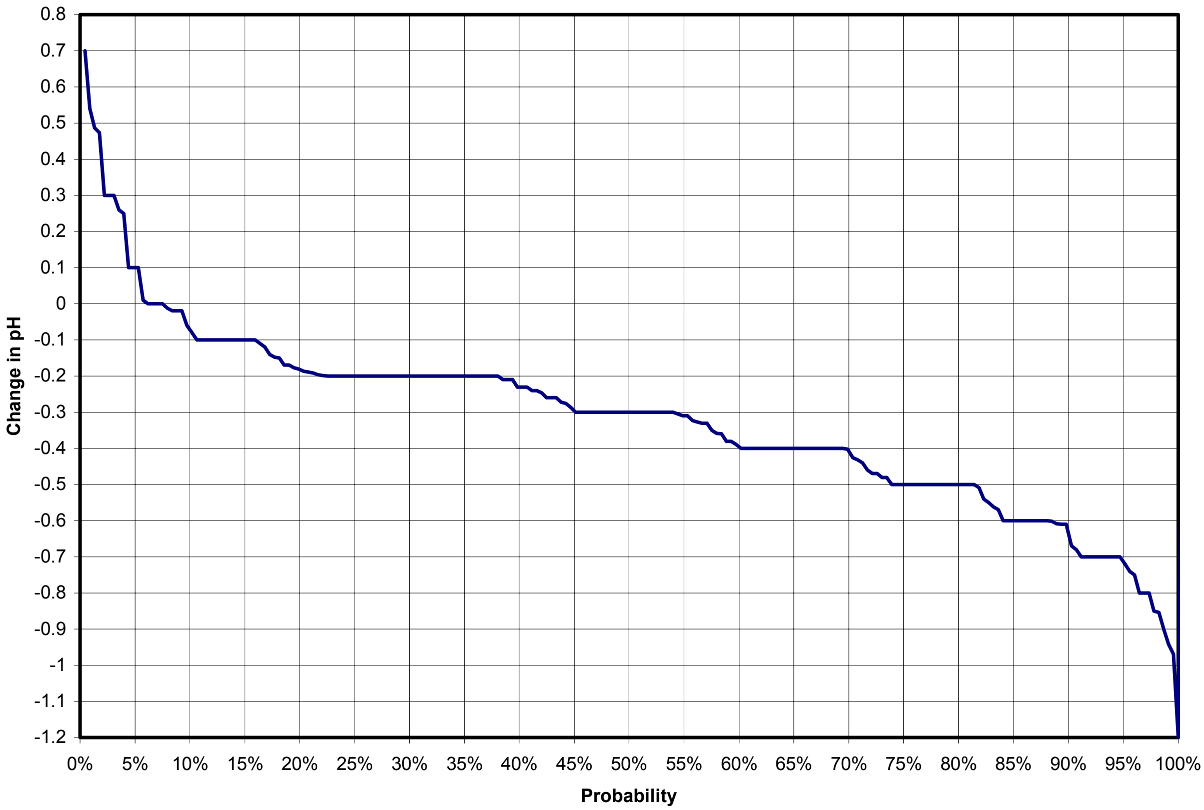


Figure D-4. Probability with which the difference between Deer Creek pH measured at the R2 (downstream) and R1 (upstream) station exceeded specified values during the period April 1, 1997 through September 30, 2001.

APPENDIX E

SUSPENDED SOLIDS AND TURBIDITY REQUIREMENTS OF FRESHWATER AQUATIC LIFE

BACKGROUND INFORMATION AND DEFINITIONS

Turbidity is the optical property of a suspension that causes light to be scattered and absorbed rather than transmitted through the water column. The scattering and absorption of light is caused by: 1) water; 2) suspended particulate matter ranging in size from colloidal to coarse dispersions; and 3) dissolved chemicals (Wetzel 1983; Boyd 1990). Suspended materials may include suspended sediments, finely divided organic and inorganic compounds, plankton, and other microscopic organisms (APHA 1985).

Because turbidity is caused primarily by suspended solids, these two parameters (suspended solids and turbidity) are often discussed together. Suspended solids concentration in water is quantified by filtering a known volume of water through a weighed standard glass-fiber filter, and drying the residue retained on the filter to a constant weight at 103-105°C (APHA 1985). The "total suspended solids" (TSS) concentration within the sample is then reported as milligrams of dried residue per liter of water filtered (mg/l).

Although the terms suspended solids and turbidity are sometimes used synonymously, the degree of turbidity is not equal to the suspended solids concentration; rather, turbidity is an expression of only one effect of suspended solids upon the character of water (i.e., the ability of light to penetrate through the water column). Because the particle size and nature (e.g., organic vs. inorganic) of the suspended solids affect the light scattering, different turbidities can be measured for waters having the same TSS concentration (McKee and Wolf 1963).

Early researchers used a variety of approaches to quantify turbidity, including the "millionth intensity depth" of light penetration into the water column (Ellis 1937) and suspended solids concentration in mg/l (Wallen 1951). Early work by Ellis (1937) contributed to an understanding that *turbidity* largely affects primary production within water bodies. The concept of the "compensation point" was later developed to define the water column depth where oxygen production from photosynthesis and oxygen consumption due to respiration is equal. Above the compensation point, net oxygen production occurs throughout the daylight hours because photosynthetic oxygen production by macrophytes and algae exceed total oxygen consumption due to respiration. The compensation point is an attempt to establish the lower limit of the occurrence of plankton populations (AFS 1979). In general, photosynthesis cannot proceed at rates exceeding respiration at depths where light intensity is less than 1 percent of its value at the water surface (Boyd 1990). The stratum of water receiving 1 percent or more of the incident light is termed the "euphotic" or "photic" zone. Hence, compensation point depth is directly related to turbidity, and indirectly related TSS concentration.

More recently, researchers have developed the standard methods for determination of turbidity based on the Jackson candle turbidimeter. However, the lowest turbidity value that can be measured directly using this instrument is 25 "Jackson Turbidity Units" or

JTU. Because many natural and treated waters are less than 25 JTU, indirect secondary methods of measurement are required. These methods employ instruments that measure the intensity of light scattered at a 90^0 angle to the light entering the sample. These turbidimeters called “nephelometers” are relatively unaffected by small changes in design parameters and, therefore, are specified as the standard instrument for the measurement of low turbidities. These instruments measure turbidity in “Nephelometric Turbidity Units” or NTUs (APHA 1985).

Nephelometers compare the intensity of light scattered by a sample to the intensity of light scattered by a standard reference suspension. The reference nephelometer standard is a suspension of the polymer Formazin. Nephelometric turbidity units (NTUs) based on formazin are approximately equal to JTUs measured with the Jackson Candle Turbidimeter (i.e., JTU)(APHA 1985).

All surface water bodies have quantifiable levels of suspended solids and turbidity. The numerous scientific studies conducted over the past 50-60 years indicate that there is no sharply defined concentration of suspended solids and associated turbidity level above which aquatic communities are harmed. Rather, the magnitude and type of impact(s) on aquatic life are species-specific and determined by concentration and type of suspended solids and turbidity, as well as the duration of exposure.

In general suspended solids influence plant and algal communities through their effects on turbidity. The influence (both positive and negative) of turbidity on plant communities can be measured in the clearest and the most turbid of waters. Suspended solids, particularly when at high levels, directly affect fish and macroinvertebrates, whereas turbidity acts indirectly through its effects on primary production, food availability, and risk of predation. Direct injury to fully developed fish by nontoxic suspended matter has been demonstrated in numerous studies only at concentrations that are uncommon in both natural and polluted waters. A technical discussion of the impacts of suspended solids and associated turbidity is provided below.

TURBIDITY AND SUSPENDED SOLID LEVELS OF AMBIENT WATERS

Turbidities of fresh waters vary greatly with location and season (see Ellis 1937). The headwaters of streams and rivers generally have low turbidities (e.g., often below 5 NTUs) throughout the year. Larger rivers, located at lower elevations, typically have higher turbidities (e.g., <10 to over 100 NTUs). In 1945, it was reported that, among inland waters of the United States supporting a varied fish fauna, about 5 percent had a suspended solids concentration under 72 mg/l; about 50 percent under 169 mg/l; and about 95 percent under 400 mg/l (McKee and Wolf 1963). The turbidity of all water bodies increases during and following precipitation events that result in highly turbid runoff. Hence, turbidities of most riverine systems are lowest at times furthest removed from runoff events, and highest during and immediately following large storms that result in high rates of runoff. Total suspended solid levels in natural waters seldom exceed 20,000 mg/l for more than a few days (Boyd 1990).

Effects of Turbidity and Suspended Solids on Aquatic Life

Aquatic Plants

The growth and photosynthetic rates of fixed and suspended aquatic plants is directly affected by the light intensity reaching them. In most aquatic systems, suspended solids and turbidity levels are important in defining the composition, structure, and photosynthetic activity of the aquatic plant and algal communities. Boyd (1990) reported that macrophyte growth increases with increasing concentrations of key nutrients, and often with increasing alkalinity, but probably the most critical factor regulating macrophyte growth is turbidity. Reactions of plant communities (both "positive" and "negative") can be measured across the entire spectrum of suspended solids and turbidity levels encountered in ambient waters. Increasingly high levels of suspended solids and turbidity can adversely affect aquatic systems by limiting the depth to which light can penetrate into the water column, thereby limiting the depth of the "photic zone" and primary production.

Fish

Fish (and benthic macroinvertebrates) are generally not directly affected by suspended solids and turbidity, unless they reach relatively high levels. When the levels of suspended solids (and thus turbidity) become extremely high, they can adversely impact fish and macroinvertebrates by making it difficult for sight feeders to locate prey, causing abrasive injuries, clogging gills and respiratory passages, and/or by blanketing the streambed, thereby killing incubating fish eggs/larvae and benthic macroinvertebrates (McKee and Wolf 1963; EIFAC 1965; USEPA 1973; Alabaster and Lloyd 1980). Moreover, high suspended solids and turbidity levels can indirectly impact fish and macroinvertebrates through reductions in primary production that, in turn, may limit food supplies and thus reduce growth rates, and by carrying down and trapping bacteria and organic wastes on the bottom, which can lead to noxious conditions and oxygen depletion (McKee and Wolf 1963; EIFAC 1965; Alabaster and Lloyd 1980). Decreased visibility in waters having moderately high turbidities can benefit the early life stages of fish and other prey organisms by providing visual protection from predators.

Mortality Resulting from Short-term Exposures

Numerous studies have been conducted over the years on the acute lethality of suspended solids. A brief review of findings from key studies is presented here. Griffin (1938) stated that Pacific salmon and trout fingerlings lived for 3-4 weeks at suspended solids levels of 300-750 mg/l with short daily increases to 2,300-6,500 mg/l caused by stirring up sediments. Wallen (1951) conducted a study that investigated the direct short-term effects of suspended montmorillonite clay on 14 species of warmwater fishes. In this study, suspended solids levels were increased for a short time each day by stirring the sediment. A summary of his findings was presented by McKee and Wolf (1963), and is provided below. The lowest concentration of suspended solids for which mortality was observed was with pumpkinseed sunfish (*Lepomis gibbosus*) exposed to

16,500 mg/l daily for an average of 13 days. Rock bass (*Ambloplites rupestris*) was the species for which the lowest reported suspended solids level (38,250 mg/l) consistently caused mortality due to daily exposures of less than one week. Some level of mortality was observed for all species tested when exposed daily to 100,000 to 175,000 mg/l montmorillonite clay suspensions over a 1- to 2-week period. At suspended solids levels causing mortality, the opercular cavities of test fish were matted with clay, and the gills were covered with a layer of clay. Harmful non-lethal effects were first observed when suspended solids levels approached 20,000 mg/l.

This study clearly demonstrated that the tolerance of various fish species can differ widely. Kramer and McLeod (1965, as cited in Alabaster and Lloyd 1980) found that walleye *(Stizostedion vitreum vitreum*) experienced mortality within 72 hours of exposure to 100 mg/l of various wood pulps, but that 20,000 mg/l did not kill fathead minnows (*Pimephales promelas*) exposed for 96 hours.

Common Name of Fish	*Range of Temperature °C*	*Average Time of Test, Days*	*Fatal Turbidity in mg/l*		
			Minimum	*Average*	*Maximum*
Golden shiner	20-29	7.1	55,000	166,000	200,000
Mosquito fish	20-28	16.5	120,000	181,500	225,000
Goldfish	24-32	12.0	90,000	197,000	270,000
Green sunfish	20-29	5.5	50,000	166,500	225,000
Black bullhead	22-32	17.0	175,000	222,000	270,000
Red shiner	22-32	9.0	175,000	183,000	190,000
River carpsucker	24-32	9.6	105,000	165,000	250,000
Largemouth bass	16-32	7.6	52,000	101,000	150,000
Pumpkin seed	16-22	13.0	16,500	69,000	120,000
Orangespotted sunfish	22-32	10.0	100,000	157,000	200,000
Channel catfish	24-32	9.3	--	85,000	--
Blackstrip top-minnow	22-26	19.3	--	175,000	--
Black crapple	28-29	2.0	--	145,000	--
Rock bass	--	3.5	--	38,250	--

Source: Wallen (1951, as summarized by McKee and Wolf 1963).

Mortality Resulting from Long-term Exposures

Other studies have investigated chronic or long-term effects of suspended solids levels on fish. Van Oosten (1945) concluded from a literature review that average suspended solids levels of up to 200 mg/l are harmless to fish, and that they can thrive in waters having TSS levels over 400 mg/l and averaging 200 mg/l. Similarly, Ward (1938, cited in McKee and Wolf 1963) reported that turbidity as high as 245 mg/l is not harmful to fish. Herbert and Merkens (1961) conducted experiments on the survival of rainbow trout in suspensions of inert solids (kaolin and diatomaceous earth). Results showed that concentrations of 30 mg/l caused no increase in mortality over control fish; mortality increased slightly at 90 mg/l, and substantial additional mortality occurred in 2-12 weeks when test fish were continuously exposed to 270 mg/l and higher levels of these solids. Herbert and Wakeford (1962) observed no mortality in rainbow trout exposed to a suspension of 553 mg/l gypsum for a 4-week period. Similarly, there was no mortality of rainbow trout exposed for 9-10 months to 200 mg/l of suspended solids from a coal washery (Herbert and Richards 1963). These later studies indicate that the *general* conclusions regarding the effects of suspended solids on fish reached by early investigators, such as those cited above, may hold for certain types of suspended solids, but not others. In fact, these studies suggest that the effects of suspended solids on a given species of fish can vary widely, depending upon the type or nature of suspended solids to which fish are exposed. From a literature review, Newcombe and Jensen (1996) indicated that long-term exposure (e.g., 4 months or more) to suspended sediment concentrations of 20-55 mg/l or more would be required before mortality would occur in juvenile and adult salmonids and adult non-salmonids.

Growth, Production, Risk of Predation and Population-level Effects

The growth (and survival) of larval lake herring were not affected by exposure for 62 days to red clay concentrations of up to 28 mg/l (Swenson and Matson 1976, cited in Alabaster and Lloyd 1980). Laboratory experiments in which the amount of food made available to trout was limited showed that 50 mg/l wood fiber and coal washery waste suspended solids reduced growth rates. These impacts increased with increasing suspended solids concentrations. However, growth impacts were less evident when there was abundant food supply (Herbert and Richards 1963). Sigler et al. (1984) reported that turbidities (caused by clay) as low as 25 NTUs caused a reduction in growth in young steelhead (*Oncorhynchus mykiss*) and coho salmon (*Oncorhynchus kisutch*). Turbidities at this level correspond to suspended solids concentrations of approximately 50 mg/l. Feeding tests conducted by Breitburg (1988) showed no significant reduction in the number of copepods or daphnids eaten by striped bass larvae per 25-min feeding period between suspended solids levels from 0 to 75 mg/l. An increase in the prey capture rate at 75 mg/l compared to 0 mg/l occurred when *Daphnia pulex* were used as prey.

Buck (1956) studied the growth of fish over a two-year period in 39 farm ponds that were cleared of fish and then restocked with largemouth bass, bluegill, and red ear sunfish (*Lepomis microlophus*). He observed maximum production (161.5 lb/acre) in farm ponds where average suspended solids was less than 25 mg/l. Production dropped to 94 lb/acre (a relative reduction of about 42%) in ponds having suspended solids levels of between 25 and 100 mg/l, and to 29.3 lb/acre (a relative reduction of about 82%) in ponds where the suspended solids often exceeded 100 mg/l. Differences were attributed to the greater availability of prey organisms in the "clear" ponds. The rate of reproduction of all of these species was reduced at suspended solids levels of about 75-100 mg/l or greater. Lower growth rates for largemouth bass, crappies (*Pomoxis spp.*) and channel catfish (*Ictalurus punctatus*) also were found in a reservoir having an average suspended solids level of 130 mg/l, relative to another reservoir where the water was always substantially clearer. In a stream where suspended solids levels increased from a range of 13-52 mg/l upstream of a limestone quarry to a range of 21-250 mg/l downstream, Gammon (1970) found that most fish numbers were lower downstream.

Schubel et al. (1974) showed that laboratory suspensions of natural, fine-grained sediments from Chesapeake Bay up to 500 mg/l had no measurable effect on the success of egg hatching for yellow perch (*Perca flavescens*) or striped bass (*Morone saxatilis*). However, this study did document significantly lower hatching success for both species at concentrations of 1,000 mg/l. Based on literature review, Alabaster and Lloyd (1980) concluded that impacts on incubating fish eggs is less a function of the suspended solids levels or turbidity levels, than it is the amount of material that will settle out of suspension, thereby covering incubating eggs and reducing gas exchange with the surrounding water. Hence, suspended solids and turbidity levels that cause little to no deposition of finely divided solids tended not to adversely affect the reproductive success of bottom-spawning fishes.

Field tests in England, showed that a stream containing 60 mg/l of suspended solids had just as many trout and invertebrates as a "clear" control stream (Alabaster and Lloyd 1980). Similarly, Herbert et al. (1961) found that 1,000 to 6,000 mg/l of suspended solids from china-clay wastes reduced the density of brown trout to about one-seventh of that found in clear streams, but that a normal trout population was present in a river having suspended solids levels of 60 mg/l. Liepolt (1961) (cited in Alabaster and Lloyd 1980) reported that a trout fishery existed in a stream having suspended solids levels typically between 19 and 23 mg/l, and that the fishery was not harmed by dredging operations that raised the suspended solids levels to 160 mg/l for short periods. In a concurrent field test in the River Fal, that had 1,000 mg/l suspended matter, trout were observed to be at densities one-seventh and invertebrates one-third those in control streams (McKee and Wolf 1963).

Gradall and Swenson (1982) studied the responses of brook trout (*Salvelinus fontinalis* – a predator) and creek chub (*Semotilus atromaculatus* – prey species) to red-clay turbidity in the laboratory. Creek chub preferred highly turbid water (57 NTUs) over moderately turbid water (6 NTUs), but brook trout did not show a preference for either. In moderately turbid water, both species were more active and used overhead cover less than in clear water. The results from this study indicate that turbidity may represent an important isolating mechanism that promoted production of the prey species. These findings further demonstrate that turbidity increases are not necessarily adverse to fish communities; rather, low to moderate turbidities (e.g. <10 NTUs) may provide as many or more positive compared to negative effects. The negative effects outweigh the positive influences when turbidities become significantly higher than normal levels.

MINIMUM EFFECT LEVELS

Fish

Based on their comprehensive review of the scientific literature, Newcombe and Jensen (1996) concluded that the lowest suspended sediment concentration that had measurable effects on warmwater fishes was 10-20 mg/l. Johnson and Wildish (1982) documented a change in the depth preference of Atlantic herring upon exposure to 10 mg/l suspended solids for three hours. These same researchers reported that Atlantic herring showed reduced feeding rates when exposed to 20 mg/l for three hours. Also stated in Appendix A of Newcombe and Jensen (1996) is a study by Vinyard and O'Brien (1976) that documented reduced capacity to locate prey in bluegill exposed to 15 mg/l suspended solids for one hour. Although measurable effects over short time frames, such behavioral changes would not be expected to result in adverse impacts to the species' population in the wild. CDFG reviewed Vinyard and O'Brien (1976) and concluded that a 30-day average TSS requirement of 10 mg/l should be included in the revised DCWWTP NPDES permit for May through October. The CDFG further stated that, based on findings reported by Newcombe and Jensen (1996), "… *the recommended monthly maximum concentration of 10 mg/l would alleviate our concerns regarding chronic exposure to TSS.*" (CDFG 1997).

Alabaster and Lloyd (1980) cited several studies that reported the loss of fish communities in rivers downstream from the discharge of large quantities of suspended solids. However, the affected fish reappeared downstream of where suspended solids levels were reduced to 100-200 mg/l. Moreover, Alabaster and Lloyd (1980) presented results of a questionnaire sent to River Boards in Great Britain regarding the effects of suspended solids of industrial origin on fish populations. With few exceptions, fisheries in streams having suspended solids above 100 mg/l were either severely harmed or absent, whereas fisheries in streams with suspended solids concentrations below about 80-100 mg/l were in good condition. Care was taken in this review to not include data for streams that were polluted with materials other than inert suspended solids.

Based on available literature regarding chemically inert suspended solids in waters that are otherwise satisfactory for the maintenance of freshwater fisheries, the EIFAC (1965) concluded the following (as presented in USEPA 1973):

- there was no evidence that concentrations of suspended solids less than 25 mg/l have any harmful effects on fisheries;
- it should usually be possible to maintain good or moderate fisheries in waters that normally contain 25-80 mg/l suspended solids; other factors being equal; however, the yield of fish from such waters might be somewhat lower than from those in the preceding category;
- waters normally containing from 80-400 mg/l suspended solids are unlikely to support good freshwater fisheries, although fisheries may sometimes be found at the lower concentrations within this range; and
- only poor fisheries are likely to be found in waters that normally contain more than 400 mg/l suspended solids.

The U.S. EPA's 1972 water quality criteria document (USEPA 1973) quotes findings from EIFAC (1965). Since the EIFAC issued its report on suspended solids in 1965, numerous additional research articles and technical reports have become available on the topic, including review articles by Hollis et al. (1964), Gammon (1970), Ritchie (1972), Sorensen et al. (1977) and Alabaster and Lloyd (1980). The data provided in these articles support the conclusions drawn in the original EIFAC report (EIFAC 1965). Based on their review of the literature, Alabaster and Lloyd (1980) reiterated the above bulleted statements initially presented by EIFAC (1965) as tentative water quality criteria for suspended solids.

Newcombe and Jensen (1996) performed a "meta-analysis" of 80 published reports on fish responses to suspended sediments, and developed empirical relationships between observed biological response and duration of exposure and suspended sediment concentration. These relationships indicated that long-term exposures (e.g., 4 months or more) to suspended sediment concentrations of approximately 20 mg/l or more would be required before fish growth rates or density would be reduced for juvenile and adult salmonids and freshwater non-salmonids.

Based on the literature reviewed, and with the exception of minor behavioral responses that would not be expected to result in adverse population-level effects, it is concluded that suspended solids concentrations below 20-25 mg/l (and resulting turbidity) would result in little, if any, measurable affects on fish populations and communities. Possible exceptions include egg and larvae mortality and reduced growth rates in salmonids (Newcombe and Jenson 1996). It should be noted that 20-25 mg/l suspended solids concentrations relate to turbidity levels well above 5 NTUs, which is the upper end of conditions for which the proposed amendment would apply in Deer Creek.

Benthic Macroinvertebrates

The effects of suspended solids and associated turbidity on macroinvertebrates partially depend on the nature of the suspended particles present. A study conducted by Robinson (1959) found that pond sediment had no measurable adverse effects on *Daphnia magna* at concentrations as high as 1,458 mg/l, but that charcoal and montmorillonite clay caused adverse impacts at 100 mg/l, ground glass at 98 mg/l, chlorite at 120 mg/l, and illite at 264 mg/l. Adverse effects can occur at relatively low turbidity when contaminants (e.g., pesticides) are adsorbed to suspended particles. Alabaster and Lloyd (1980) discussed results from two similar studies conducted with cladocerans and copepods. Pooling the information from both studies, harmful effects were reported for these organisms at suspended solids (clay, charcoal, soil, and sand) concentrations ranging from 82-500 mg/l. Much lower concentrations (e.g., 39 mg/l kaolinite and 73 mg/l pond sediment) appeared to increase the reproductive rate of *Daphnia*.

Although they are important fish food items in lakes, *Daphnia* are less important in rivers than benthic macroinvertebrates. Benthic macroinvertebrates are not only at risk from suspended solids, but also from the accumulation of particles that settle on the stream bottom (Alabaster and Lloyd 1980). In a 4-year study of a stream receiving sediment input from a limestone quarry, Gammon (1970) reported that suspended solids concentration increases of up to 40 mg/l above normal resulted in increased drift and reduced macroinvertebrate density in impacted riffles below the quarry. When the concentration of suspended solids increased from 13-52 mg/l upstream of the quarry to 21-250 mg/l downstream, benthic macroinvertebrates preferring silt or mud substrate increased in abundance while others such as the net-spinning species (e.g., *Cheumatopsyche spp*.) were reduced in number.

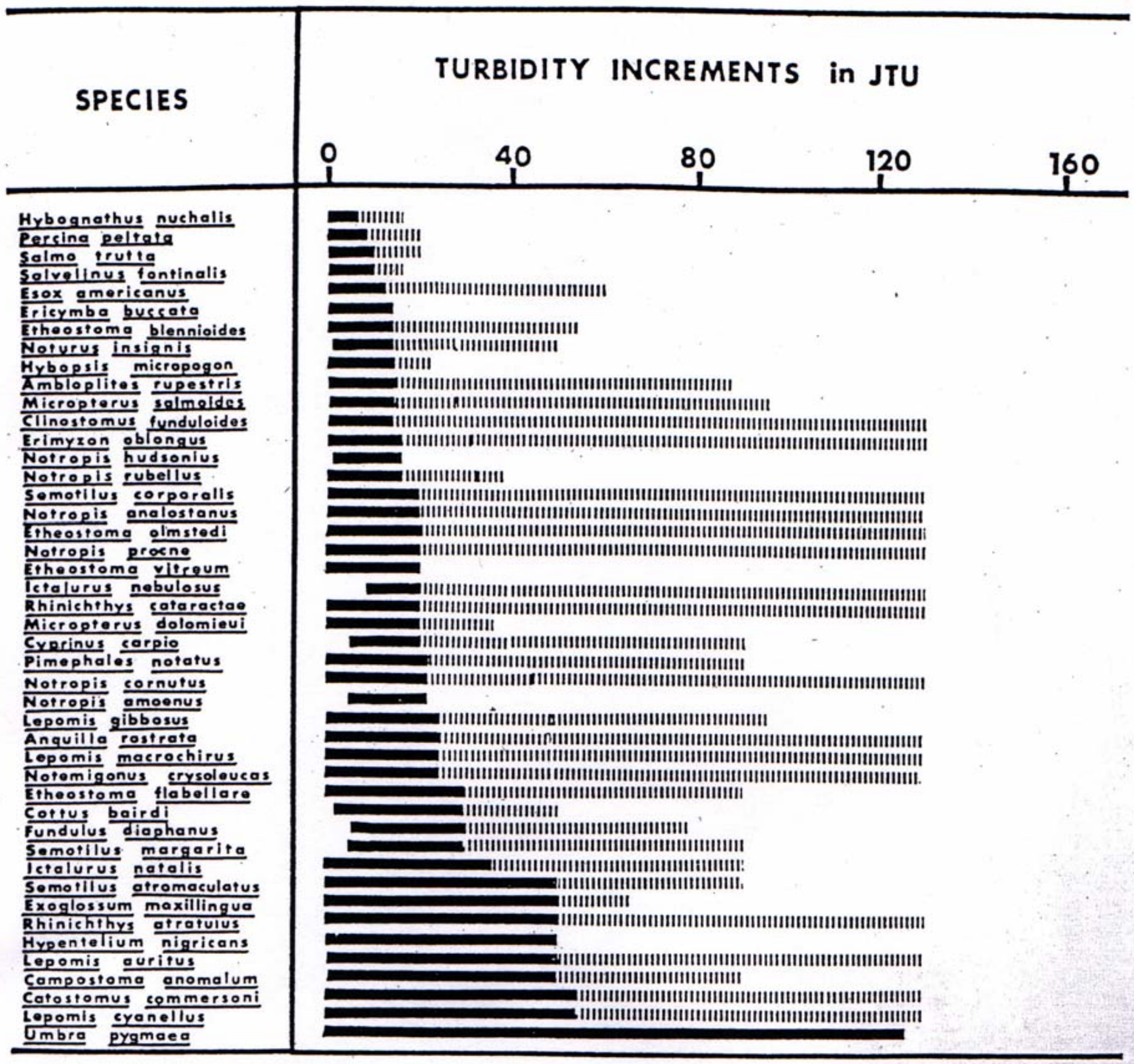
Alabaster and Lloyd (1980) discussed findings from a study conducted in France regarding increased suspended solids loading to a river from a sand-washing plant. The downstream benthic macroinvertebrate community essentially disappeared from the point of discharge, but reappeared in a condition closely approximating that of the upstream community four kilometers downstream where suspended solids levels had fallen to 29 mg/l. A similar study reported that downstream of a coal mining operation, a sparse fauna reappeared where suspended solids levels had fallen to approximately 100 mg/l.

Finally, although benthic macroinvertebrates numbers may be reduced by finely-divided chemically-inert solids, light deposits of some kinds of organic solids (e.g., humus from wastewater treatment plants) can support dense populations of some bottom-dwelling invertebrates, such as *Chironomus riparius* and *Asellus aquaticus*, which provide an abundant food supply for fish.

As with all ecosystems, the benthic macroinvertebrates that occur in rivers and streams are in balance with the physical, chemical, and biological factors that define the system. Low-level changes (e.g., changes in waters having suspended solids levels less than 25 mg/L) in suspended solids concentrations (be they inert inorganic or organic in nature) may result in subtle changes in the structure of macroinvertebrate communities, but should not cause significant adverse impacts to community composition, structure, or function. It should again be noted that the 20-25 mg/l suspended solids “no observed effect concentration” derived from the literature discussed above relates to turbidity levels well above 5 NTUs, which is the upper end of conditions for which the proposed amendment would apply in Deer Creek.

EFFECTS OF TURBIDITY ASSOCIATED WITH WASTEWATER DISCHARGES

As stated above, the nature of the suspended matter plays a significant role in its effects on fish for a given suspended solid concentration. Tsai (1973) studied fish populations downstream from the point of discharge of more than 100 wastewater treatment plants. Upstream turbidity averaged 12 ± 11 JTU and downstream turbidity averaged 34 ± 22 JTU. Because of the wide seasonal variability in background turbidity, turbidity “increment” was used to assess its affects on downstream fish communities. Statistical analyses revealed that 50% reduction in a species diversity index occurred at a turbidity increment of 20 JTU, with a 25% reduction occurring at 8 JTU. The presence of 45 fish species upstream and downstream of the wastewater plants was assessed in relation to turbidity. For most fish species, occurrence was detected over a narrow range of turbidities downstream compared to upstream. This may indicate that they were less tolerant of the suspended organic matter discharged from wastewater plants, than to the more inert upstream sediment-derived turbidity. However, these data also could be caused by confounding factors such as oxygen depletion due to organic loading above certain turbidity levels and/or the presence of materials such as chlorine and ammonia. These same considerations of confounding factors associated with this study’s analyses must also be considered when interpreting the relationships discussed between incremental increases in turbidity and reduced diversity, reported above. Regardless, all 45 fish species were present downstream when the incremental increase in downstream turbidity due to wastewater discharges was in the range of 0 to 10 JTU.



Occurrence range, at 135 Type I sewage treatment plants, of 45 species of fish at upstream stations (hatched column) and downstream stations (solid column) with respect to turbidity increment at downstream stations.

Perspective on Turbidity Effects on Aquatic Life from the AFS, and Turbidity Criteria Currently in Effect for other Western States and in Canada

In its review of the U.S. EPA's Red Book, the American Fisheries Society (AFS) stated that Oregon and Washington State Water Quality Standards "… *are especially strict when applied to turbidity*" (AFS 1979). For example, AFS (1979) defined the State of Washington's turbidity standard [in 1979] as follows:

> *"Turbidity shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU, not to exceed a maximum increase of 25 NTU."*

The State of Washington maintains this turbidity criterion today for protection of its highest quality rivers and streams; however, the second part of the criterion (i.e., not to exceed a maximum of 25 NTUs) has been dropped (M. Hicks, Washington State Department of Ecology, pers. comm., 1998). AFS (1979) further reported that the State of Wyoming's turbidity standard [in the late 1970s] was established as a maximum increase of 10 JTU for game fish and 15 JTU for non-game fish. Wyoming's current turbidity criteria read as follows:

> *"(a) In all Class 1 and 2 waters which are coldwater fisheries, the discharge of substances attributable to or influenced by the activities of man shall not be present in quantities which would result in a turbidity increase of more than 10 nephelometric turbidity units (NTUs).*
>
> *(b) In all Class 3 waters and in Class 1 and 2 waters which are warmwater fisheries, the discharge of substances attributable to or influenced by the activities of man shall not be present in quantities which would result in a turbidity increase of more than 15 NTUs.*

The Ministry of Environment for the Province of British Columbia published a document titled: *Water Quality Criteria for Particulate Matter* (Singleton 1985). The recommended turbidity criteria for the protection of aquatic life (freshwater, estuarine, and marine) published in this document read as follows: "*Induced turbidity should not exceed 5 NTU when background turbidity is ≤50 NTU, nor should induced turbidity be more than 10% of background when background is >50 NTU.*"

In short, the scientific literature compiled and discussed in this appendix, as well as turbidity criteria discussed above for the states of Oregon and Washington and the Province of British Columbia, demonstrate that the turbidity levels being addressed by the proposed amendment are far below levels that would have demonstrable effects on freshwater aquatic life.

APPENDIX F

CHARACTERIZATION OF SEASONAL TURBIDITY LEVELS IN DEER CREEK AND THE DCWWTP EFFLUENT

DEER CREEK UPSTREAM OF THE DCWWTP

Historic suspended solids data are not available for Deer Creek upstream of the DCWWTP, but weekly turbidity data collected immediately upstream of the DCWWTP (R1) are available from *in situ* self-monitoring measurements taken by the District. The R1 monitoring station is located upstream of the point of effluent discharge from the DCWWTP – specifically at the road bridge crossing of Deer Creek's main channel. Summary statistics of Deer Creek turbidity data collected at the R1 (upstream) monitoring station for the period March 1, 2000 through September 30, 2001, which corresponds to when the District began weekly monitoring in the creek for NPDES reporting purposes, are provided in **Table F-1**. The probabilities with which specified turbidity levels were exceeded at R1 during this period, based on these weekly *in situ* data, are presented in **Figure F-1**.

Table F-1. Summary statistics characterizing Deer Creek turbidity (NTU) at the R1 (upstream) station, compiled from weekly *in situ* measurements made by the District for inclusion in Discharge Monitoring Reports, for the period March 1, 2000 through September 30, 2001.

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
N[a]	6	23	33	8	10	10	9	9	8	5	4	4
Mean	3.2	28.1	8.6	8.2	9.0	0.7	1.1	1.0	0.9	5.1	0.7	1.1
Median	3.2	12.0	2.6	1.9	0.9	0.7	1.0	1.1	0.9	1.8	0.6	1.1
SD[b]	2.1	42.1	16.0	16.2	18.8	0.3	0.3	0.1	0.3	6.3	0.2	0.1
High	5.5	200	90.0	48.0	58.0	1.1	1.5	1.2	1.5	15.0	1.0	1.2
Low	0.9	1.6	1.2	1.0	0.4	0.2	0.8	0.8	0.5	0.6	0.5	1.0

[a] Number of measurements in the data set for the month.
[b] Standard deviation of the mean.

Based on the weekly *in situ* measurements reported by the District for the period March 1, 2000 through September 30, 2001, and summarized in Table F-1, the range of Deer Creek turbidity at the R1 (upstream) monitoring station ranged from a low of 0.2 NTU in June to a high of approximately 200 NTUs in February. Monthly mean turbidities ranged from 0.7 to 28.1. The seasonal high turbidities occur in the winter months, when Deer Creek receives large amounts of runoff from storm events. Seasonal low turbidity levels occur in the summer and fall periods which are unaffected by precipitation events. In fact, summer/fall turbidities at the R1 station average approximately 0.7 to 1.1 NTUs during periods unaffected by precipitation (Table F-1), with instantaneous values recorded as low as 0.2 NTU. These turbidity data indicate that Deer Creek experiences three orders of magnitude variation in turbidity on a seasonal basis.

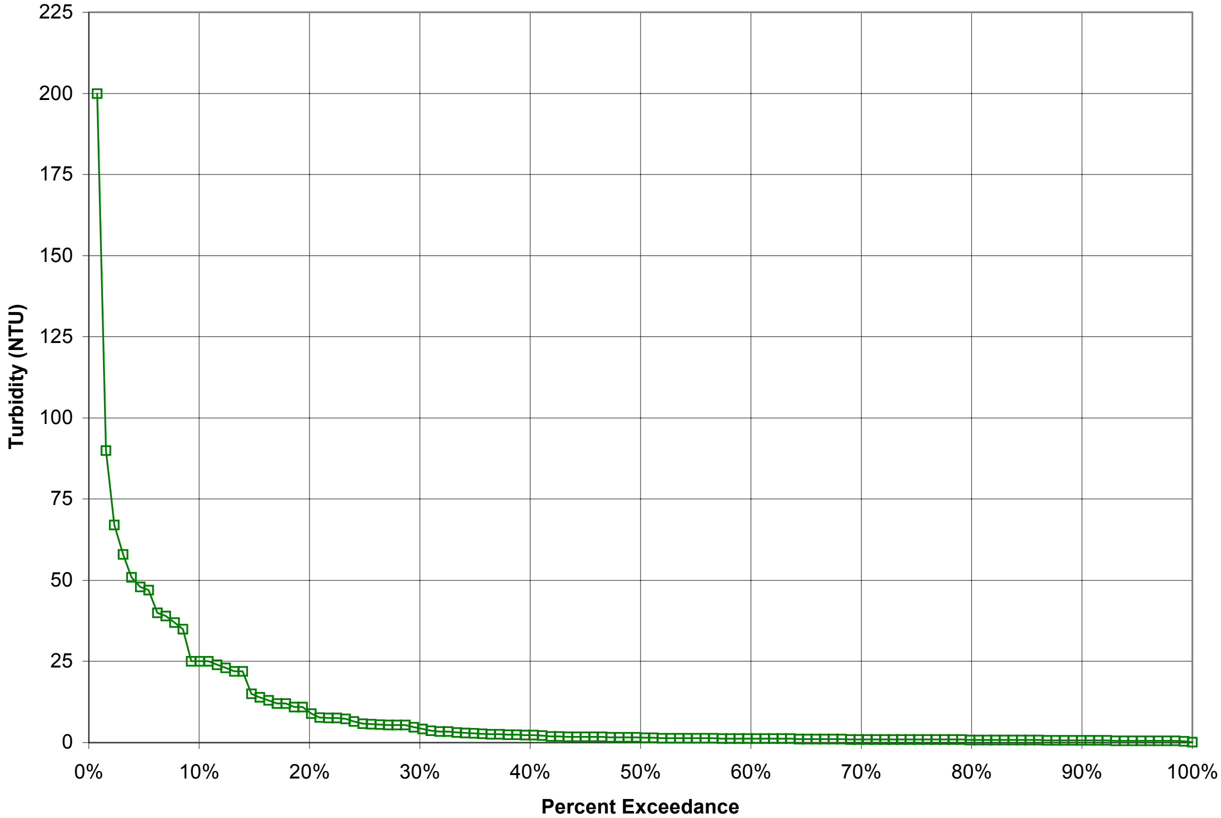


Figure F-1. Probability with which the turbidity of Deer Creek at the R1 (upstream) station exceeded specified values during the period March 1, 2000 through September 30, 2001.

EFFLUENT

Significant upgrades to DCWWTP facilities and operations were made in 1996 and early 1997. Upgrades affecting effluent quality were completed in late March 1997. Hence, all data discussed in this subsection are after April 1, 1997 so that they accurately characterize post-upgrade effluent quality. Because effluent turbidity is related to effluent TSS levels, and because most literature pertaining to effects on aquatic life relates effects to TSS concentrations rather than turbidity per se, both parameters will be discussed for the DCWWTP effluent.

Compilation of daily effluent TSS data from the District's Discharge Monitoring Reports indicates that daily maximum effluent TSS levels were between 4 and 8 mg/l during the months June through November, and between 5 and 34 mg/l during the months December through May. The median values ranged from <2 to 2 mg/l for each month.

Table F-2. Summary statistics characterizing effluent total suspended solid levels (mg/l), compiled from daily *in situ* measurements made by the District for inclusion in Discharge Monitoring Reports, for the period April 1, 1997 through September 30, 2001.

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
N[a]	124	113	124	149	154	119	155	155	150	93	120	124
Median	< 2	< 2	2.0	2.0	2.0	< 2	< 2	< 2	< 2	< 2	< 2	< 2
High	18	34	5	8	24	5	8	5	5	4	4	5
Low	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2

Compilation of available daily effluent turbidity measurements compiled from the District's Discharge Monitoring Reports for the period October 1, 1999 through September 30, 2001 indicates that the daily maximum turbidity levels were between 1.7 and 2.9 NTUs for the months of June through November, and between 1.7 and 7.7 NTUs for the months December through May. Monthly mean effluent turbidities for the June through November period ranged from 0.7 to 0.9 NTUs, with monthly mean values for the December through May period ranging from 0.9 to 1.7 NTUs (**Table F-3**).

Table F-3. Summary statistics characterizing effluent turbidity (NTU), compiled from daily *in situ* measurements made by the District for inclusion in Discharge Monitoring Reports, for the period October 1, 1999 through September 30, 2001.

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
N[a]	62	57	62	60	62	60	62	62	60	62	60	62
Mean	1.5	1.7	1.5	1.3	0.9	0.9	0.9	0.7	0.7	0.7	0.7	0.9
Median	1.3	1.2	1.4	1.2	0.9	0.8	0.8	0.6	0.6	0.6	0.7	0.8
SD[b]	1.0	1.3	0.6	0.4	0.3	0.3	0.4	0.2	0.3	0.3	0.2	0.3
High	7.3	7.7	3.7	2.2	1.7	1.7	1.6	1.4	1.6	2.9	1.6	1.9
Low	0.7	0.6	0.7	0.4	0.4	0.5	0.4	0.4	0.2	0.3	0.3	0.5

[a] Number of measurements in the data set for the month.
[b] Standard deviation of the mean.

The probabilities with which effluent turbidities exceeded specified levels during the October 1, 1999 through September 30, 2001 period, based on weekly *in situ* measurements, are presented in Figure F-2. During this period, effluent turbidity exceeded 1 NTU about 38% of the time and 5 NTUs about 1% of the time. Effluent turbidity remained below 2 NTUs about 95% of the time.

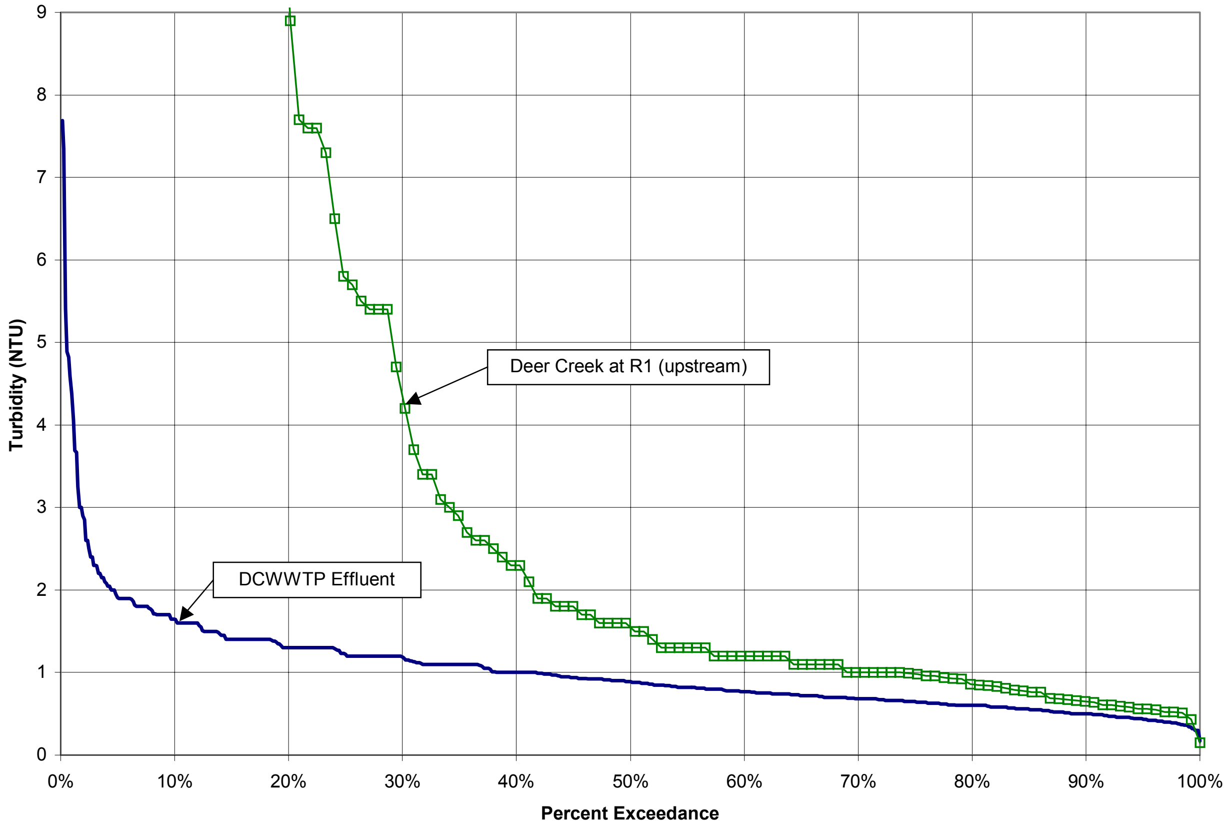


Figure F-2. Probability with which effluent turbidity exceeded specified values during the period October 1, 1999 through September 30, 2001. Effluent plot is based on daily turbidity measurements made by the District. Data for the R1 (upstream) site also are plotted for comparison purposes.

An important point should be noted when interpreting the cumulative probability plots presented here. In creating cumulative probability plots, all available data are sorted (from high to low) and then plotted. This type of plot is helpful to understand the relative frequencies with which creek and effluent turbidity exceeds specified levels, which is the reason for their inclusion in this Staff Report. However, it must be noted that in so doing, correlation in time is not represented in these plots. In reality, effluent turbidities above 1 NTU can and do occur when creek turbidity at R1 is at or below 1 NTU. Hence, Figure F-2 does indicate that DCWWTP effluent turbidity is below 1 NTU more often than is R1 turbidity. However, Figure F-2 does not indicate that effluent turbidity is always lower than R1 creek turbidity.

Deer Creek Downstream of the DCWWTP

No suspended solids data are available for Deer Creek at the R2 (downstream) monitoring station. However, weekly *in situ* measured turbidity data are available for the R2 station for the period March 1, 2000 through September 30, 2001. Summary statistics for R2 turbidity have been compiled for this period and are presented in **Table F-4**. The probabilities with which specified turbidity levels were exceeded at R2 during this period, based on these weekly *in situ* data, are presented in **Figure F-3**.

Table F-4. Summary statistics characterizing Deer Creek turbidity (NTU) at the R2 (downstream) station, compiled from weekly *in situ* measurements made by the District for inclusion in Discharge Monitoring Reports, for the period March 1, 2000 through September 30, 2001.

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
N[a]	5	3	7	8	10	9	9	9	8	5	4	4
Mean	2.2	17.5	5.3	6.0	7.0	0.9	1.3	1.1	0.8	2.6	1.1	1.0
Median	1.6	24.0	2.3	1.6	1.1	0.7	1.2	1.0	0.9	0.9	1.1	1.0
SD[b]	1.1	14.0	6.8	11.8	15.3	0.4	0.7	0.4	0.2	2.4	0.4	0.2
High	3.8	27.0	20.0	35.0	49.0	1.6	3.1	1.9	1.0	5.8	1.5	1.2
Low	1.2	1.4	1.5	0.9	0.5	0.3	0.6	0.5	0.6	0.8	0.6	0.7

[a] Number of measurements in the data set for the month.
[b] Standard deviation of the mean.

Based on the weekly *in situ* measurements reported by the District for the period March 1, 2000 through September 30, 2001, and summarized in Table F-4, the range of Deer Creek turbidity at the R2 (downstream) monitoring station ranged from a low of 0.3 NTU in June to a high of approximately 49 NTUs in May. Monthly mean turbidities ranged from 0.9 to 17.5. As with the R1 (upstream) station, the seasonal high turbidities occur in the winter months, when Deer Creek receives large amounts of runoff from storm events. Seasonal low turbidity levels occur in the summer and fall periods which are unaffected by precipitation events. In fact, summer/fall turbidities at the R2 station average approximately 0.8 to 1.3 NTUs during periods unaffected by precipitation (Table F-4).

These turbidity data indicate that the range of turbidities that occur at the R2 station is rather similar to the range of turbidities that occur at the R1 station most of the time (see Tables F-1, F-4; Figure F-4).

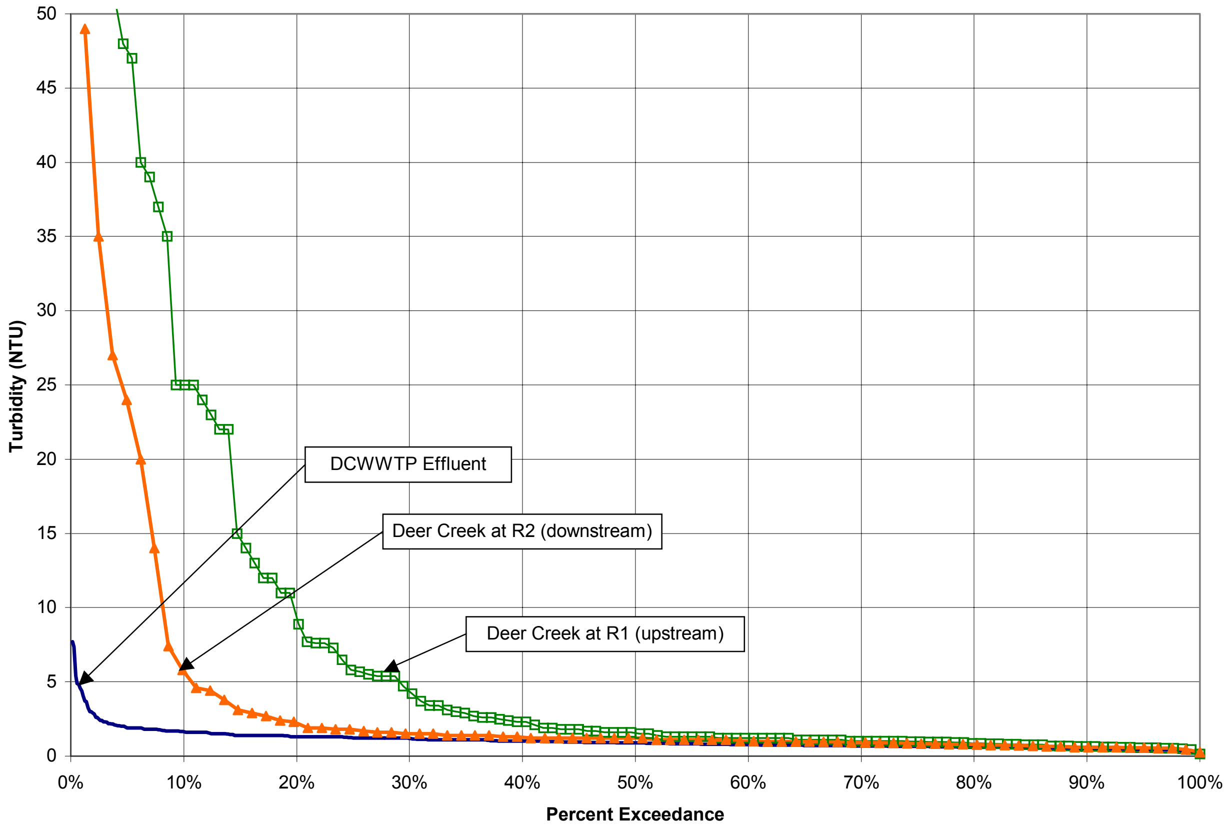


Figure F-3. Probability with which the turbidity of Deer Creek at the R2 (downstream) station exceeded specified values during the period March 1, 2000 through September 30, 2001. R2 plot is based on weekly *in situ* pH measurements made by the District. Data for the R1 (upstream) station and the effluent also are plotted for comparison purposes.

Turbidity of Deer Creek after mixing with effluent discharges exceeded 1 NTU about 60% of the time, 2 NTUs about 25% of the time, and 5 NTUs about 10% of the time. Assuming no factors other than effluent discharges (e.g., cattle grazing and creek wallowing) are affecting creek turbidities between the R1 and R2 locations, R2 turbidity would always be intermediate between turbidities determined for R1 and the effluent. Finally, it should be noted that during a substantial portion of the year, effluent discharges actually contributed to reducing, rather than increasing, downstream creek turbidity (Figure F-3 and F-4).

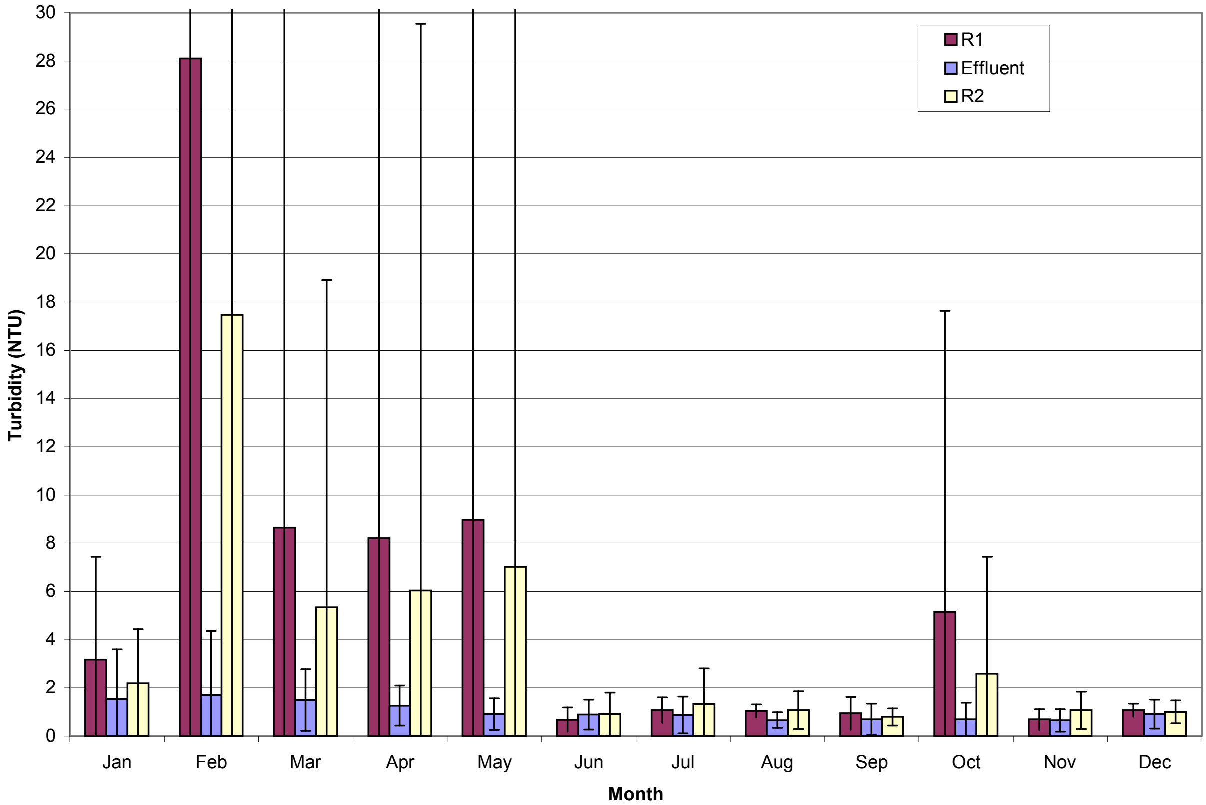


Figure F-4. Monthly average turbidity in the Deer Creek Wastewater Treatment Plant effluent, and at the Deer Creek R1 (upstream) and R2 (downstream) monitoring locations. The period for the effluent turbidity is October 1, 1999 through September 30, 2001. The period for the R1 and R2 turbidity is March 14, 2000 through September 30, 2001. Error bars represent two standard deviations of the average for each month.

APPENDIX G

LETTERS/E-MAILS FROM THE INDIVIDUALS CITED AS PERSONAL COMMUNICATIONS IN REPORT

-----Original Message-----
From: Dave Thomas [mailto:dave@robertson-bryan.com]
Sent: Thursday, February 14, 2002 8:15 AM
To: Mike Bryan
Subject: FW: Personal communication Dr. Haro

-----Original Message-----
From: Haro Roger J [mailto:haro.roge@uwlax.edu]
Sent: Thursday, February 14, 2002 4:08 AM
To: dave@robertson-bryan.com
Subject: Personal communication

Dear Mr. Robertson,

I have reviewed the statements that you have attributed to me, and find them to be appropriate and technically accurate.

Sincerely,

R. J. Haro

****
****

Roger J. Haro, Ph.D. Phone: (608) 785-6970
River Studies Center Fax: (608) 785-6959
Dept. Biology E-mail: haro.roge@uwlax.edu
University of Wisconsin - La Crosse
4028 Cowley Hall
La Crosse, Wisconsin 54601

Visit ZooLab - A website for the Animal Biology Laboratory at

<http://bioweb.uwlax.edu/zoolab/index.htm>

"Will you honestly tell me (and I should be really much obliged) whether

you believe that the shape of my nose was ordained and 'guided by an intelligent cause?'"

Chuck Darwin to Charlie Lyell (1860)
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-----Original Message-----
From: Keith Whitener [mailto:kwhitener@cosumnes.org]
Sent: Wednesday, February 13, 2002 11:33 AM
To: 'Dave Thomas'
Subject: RE: Personal Communication Reference

Dave,

I have reviewed the statements attributed to me and I find them to be appropriate and technically accurate. The only revision that I request is that the citations be altered slightly. All of the citations should include the dual listing of The Nature Conservancy and UC Davis. If for your purposes you would like to include the wording Cosumnes River Preserve that's fine also. My preferences for the citations would be The Nature Conservancy/U.C. Davis; The Nature Conservancy, Cosumnes River Preserve/U.C. Davis or TNC/UCD. I hope it isn't a hassle to change the citations.

Thanks, Keith

Keith Whitener
Cosumnes River Preserve
Project Ecologist
kwhitener@cosumnes.org
916 683-1767

-----Original Message-----
From: Dave Thomas [mailto:dave@robertson-bryan.com]
Sent: Wednesday, February 13, 2002 10:51 AM
To: kwhitener@cosumnes.org
Subject: Personal Communication Reference

Please see attachment

[Note: Additional letter/e-mails will be inserted in this section as they are received]